Epidemiological Profile of Hepatitis C in Iowa

Iowa Department of Public Health

2015

Issued December, 2016

Authors, Advisory Group, and Acknowledgements

AUTHORS

Nicole Kolm-Valdivia, Ph.D., M.P.H., HIV Prevention Program Evaluation Coordinator, Iowa Department of Public Health
Peter Corcoran, M.P.H., President, PBC3
Lena Swander, B.S., Hepatitis C Intern, Iowa Department of Public Health
Randy Mayer, M.S., M.P.H., Chief, Bureau of HIV, STD, & Hepatitis, Iowa Department of Public Health
Patricia Young, R.N., B.S., HIV & Hepatitis Prevention Program Manager, Iowa Department of Public Health

HEPATITIS EPI PROFILE ADVISORY GROUP

Julie Baker, M.P.A., Iowa Primary Care Association, Des Moines
Sue Boley, R.N., Polk County Health Department, Des Moines
Colleen Bornmueller, Family Planning Council of Iowa, Des Moines
Jerry Harms, M.P.H., C.A.R.T., Iowa Department of Public Health, Des Moines
Donald J. Hillebrand, M.D., Center for Liver Disease, Des Moines
Betty Krones, R.N., Cerro Gordo County Health Department, Mason City
Douglas LaBrecque, M.D., FACP, University of Iowa
Darla Peterson, B.S., Siouxland Community Health Center, Sioux City
Theresa Schall, R.N., B.S.N., Primary Health Care, Des Moines
Shane Scharer, M.S., Iowa Department of Public Health, Des Moines
Jack Stapleton, M.D., University of Iowa, Iowa City
Maria Steele, A.R.N.P., Iowa Digestive Diseases Center, Des Moines
Chris Taylor, National Alliance of State and Territorial AIDS Directors, Washington, D.C.
Roma Taylor, R.N., B.S.N., Scott County Health Department, Davenport
Ravi Vemulapalli, M.D., Iowa Digestive Disease Center, Des Moines
Michael Voigt, M.D., University of Iowa, Division of Gastroenterology and Hepatology, Iowa City
Toby Yak, Ph.D., M.P.H., Iowa Department of Public Health, Des Moines

This profile was funded in part through a grant provided by the Association of State and Territorial Health Officials (ASTHO)

Special thanks to:
William Brant, Iowa Department of Public Health
Knute Carter, Ph.D., University of Iowa
Alagie Jatta, M.S., Iowa Department of Public Health
Prakash Nadkarni, M.D., Ph.D., University of Iowa
Jacob Oleson, Ph.D., University of Iowa
John Warming, Iowa Department of Public Health
Michele West, Ph.D., State Health Registry of Iowa

Contents

Executive Summary

The purpose of Iowa's first hepatitis C virus (HCV) epidemiological profile is to document the burden of disease associated with viral hepatitis C in Iowa. This report focuses on chronic infection with hepatitis C virus. The goals of this profile are to:

- **Increase awareness of HCV in Iowa among the public and medical professionals;**
- **Inform policy decisions on viral hepatitis prevention, care, and planning; and**
- **Provide data to local and state public health professionals, policy makers, and health care providers for planning purposes.**

Staff within the Bureau of HIV, STD, and Hepatitis in the Division of Behavioral Health at the Iowa Department of Public Health (IDPH) developed this profile in collaboration with an advisory group made up of internal partners and external stakeholders. This advisory group included program staff across IDPH, local public health, health care providers, community members, policy advocates, and partners from other state and national organizations. This group provided feedback and guidance for the report's organization, data sources, and design.

This report is a compilation of information on the burden on HCV and HCV-related illnesses and deaths among Iowans using data collected at the state and national levels. This report also provides an overview of HCV screening recommendations and information on hepatitis resources for providers and the public. Finally, the report highlights the intersecting epidemics of hepatitis C, HIV, and injection drug use – particularly the recent increase in abuse of prescription and non-prescription opioids. The opioid abuse epidemic is fueling an outbreak of hepatitis C among people under the age of 30. Hepatitis C diagnoses among this population may be an indication of increases in injection drug use, and can be a harbinger of HCV-related morbidity and mortality to come after many years of silent infection, as is now being seen among people born from 1945 – 1965.

Findings

- As of March 31, 2016, the Iowa Department of Public Health had received 21,748 reports of hepatitis C infection among Iowans. Based upon this number of reports, there are likely to be 35,865 to 136,900 Iowans with hepatitis C infection, with 15,330 to 117,174 of these cases undiagnosed.
- HCV diagnoses have increased sharply in Iowa since 2000. Over 2,200 Iowans were diagnosed in 2015, a nearly three-fold increase since 2000. HCV diagnoses among those between the ages of 18 and 30 have more than quadrupled since 2009, with 303 diagnoses in 2015.
- There are disparities among persons living with HCV for gender and age. Over 61% of persons reported with HCV were men. The majority (63%) of persons reported with HCV were diagnosed between the ages of 45 and 64.
- Although race and ethnicity were not reported on nearly 70% of cases, there appear to be pronounced disparities by race and ethnicity. Of people for whom race and ethnicity was reported, over 10% were black and non-Hispanic. This group only makes up 3% of Iowa's total population.
- Over 55% of people living with HCV who were ages 18 to 64 reported residency in one of six counties. These counties were Polk, Linn, Scott, Woodbury, Pottawattamie, and Black Hawk.
- In 2015, IDPH began conducting surveillance follow up on people ages 30 or under reported with HCV. For those people whom data were collected, over 54% reported injection drug use.
- HCV-related hospitalizations have increased significantly since 2000 in Iowa.
- The incidence of liver and intrahepatic bile duct cancers has increased an average of 5.6% per year from 2000 to 2012 in Iowa.
- Approximately 25% of liver transplants in Iowa between 2000 and 2015 were HCV-related.
- There were 401 deaths between 2000 and 2014 with chronic viral hepatitis C listed as the primary cause of death. This represents a significant increase between 2000 (n=3) and 2014 (n=40).
- There were 215 people identified as being co-infected with HIV and HCV in Iowa.
- Heroin and opioid-related overdoses, emergency department visits, and hospitalizations increased significantly between 2008 and 2014. Injection of opioids is associated with increased risk of exposure to hepatitis C.

Abbreviations

- **AIDS:** Acquired Immune Deficiency Syndrome
- **CDC:** Centers for Disease Control and Prevention
- **CTR:** IDPH-funded Counseling, Testing, and Referral Sites
- **ED:** Emergency Department
- **eHARS:** Enhanced HIV/ AIDS Reporting System
- **HAV:** Hepatitis A Virus
- **HBV:** Hepatitis B Virus
- **HCV:** Hepatitis C Virus
- **HCC:** Hepatocellular Carcinoma
- **HIV:** Human Immunodeficiency Virus
- **IA:** Iowa
- **ICD-9:** International Classification of Diseases, Ninth Revision
- **ICD-10:** International Classification of Diseases, Tenth Revision
- **IDOC:** Iowa Department of Corrections
- **IDPH:** Iowa Department of Public Health
- **IDSS:** Iowa Disease Surveillance System
- **IDU:** Injection Drug Use
- **MSM:** Men Who have Sex with Men
- **OPTN:** Organ Procurement and Transplantation Network
- **PWID:** People Who Report Injection Drug Use
- **RNA PCR:** Ribonucleic Acid Polymerase Chain Reaction
- **SAMHSA**: Substance Abuse and Mental Health Services Administration
- **SEER:** Surveillance, Epidemiology, and End Results Program Cancer Registries
- **SHRI:** State Health Registry of Iowa-Iowa Cancer Registry
- **TEDS:** Treatment Episode Data Set
- **UNOS:** United Network for Organ Sharing
- **USPSTF:** United States Preventive Services Task Force

Definitions and Key Terms

- **Acquired Immune Deficiency Syndrome (AIDS):** Severe damage to the immune system that can occur following infection with Human Immunodeficiency Virus (HIV); defined as having had one of 26 opportunistic infections diagnosed and/or having a CD4+ cell count below 200 cells per µl or 14% of total lymphocytes.
- **Acute HCV infection:** The phase of infection immediately after acquisition of the virus. It may be asymptomatic, but people may experience weight loss, malaise, abdominal discomfort, nausea, vomiting, or jaundice, itching and dark urine. About 15 to 25% of people will clear the virus after acute infection, meaning that they are no longer infected.
- **Age-adjusted rates per 100,000:** Rate of morbidity or mortality in a population in which statistical procedures have been applied to allow for comparison across populations without regard to differences in the age of people between the populations (e.g., one population may have older people than the other population and age may be associated with a disease condition).
- **Antibody test:** A test that demonstrates the presence of antibodies (to HCV or other agent) within a person's blood. This indicates that a person was exposed to HCV and became infected, but approximately 15 to 25% of people will spontaneously clear the virus without treatment. Therefore, antibody tests do not confirm active (i.e., current) infection.
- **Baby Boomers:** People born between the years 1945 and 1965.
- **Chronic hepatitis C virus infection case definition, past or present:** A *confirmed* case of chronic HCV infection has circulating HCV RNA in their blood, confirmed by laboratory testing, and present for longer than six months. A *probable* case is one that has anti-HCV antibodies (as determined by a test called an enzyme immunoassay (EIA)) and ALT (alanine aminotransferase) values above the upper limit of normal. The diagnosis is confirmed if HCV RNA is detected by PCR.
- **Chronic hepatitis C virus infection clinical description:** Persistence of viral infection for more than 6 months is a marker of chronic infection. Long-term infection may lead to cirrhosis of the liver and hepatocellular carcinoma (i.e., liver cancer). Long-term infections cause many non-liver complications including kidney failure, neurological (nerve) damage, skin disease, depression, heart disease, diabetes mellitus and blood cancer (lymphoma).
- **Cirrhosis:** A chronic disease of the liver where chronic injury and inflammation lead to degeneration of cells and their replacement by fibrous scar tissue. Cirrhosis may be caused by exposure to viruses, chemicals, or prescription medications; heavy use of alcohol; obesity or diabetes; cystic fibrosis; or bile-duct disease.
- **Confidence interval (CI):** A confidence interval is a range around a measurement that conveys how precise the measurement is. For a 95% CI, the margin of error is 95 percent,

meaning there is a 95 percent chance that the measurement of interest falls within the stated range.

- **Human Immunodeficiency Virus (HIV):** A single-stranded ribonucleic acid retrovirus that attacks cells of the immune system, potentially leading to Acquired Immune Deficiency Syndrome (AIDS).
- **Incidence:** Number of new cases of a disease or infection within a specific population or geographical area within a specified period of time.
- **Morbidity:** Occurrence of an illness or condition in a population.
- **Mortality:** Occurrence of death in a population.
- **Prevalence:** Number of persons living with a disease or infection per 100,000 population (or sometimes written as the percentage of a population with a disease or condition).
- **Rates:** Change (in the number of cases, for example) over time per 100,000 population; rates are used to compare the impact of a disease across two or more groups.
- **Risk factor:** Any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury.
- **HCV RNA PCR test: A** test that detects hepatitis C virus RNA, indicating that a person is actively infected with HCV.
- **Seroprevalence:** Number of persons with serologic blood markers (antibodies) indicative of prior exposure to, or current active disease.

Introduction

Hepatitis C is an infectious liver disease caused by the hepatitis C virus (HCV). HCV causes hepatitis (inflammation of the liver), and is transmitted from person to person via blood or, to a much lesser extent, bodily fluids like semen. An estimated 4.6 million people (range of 3.4 to 6 million) are currently infected with chronic hepatitis C in the United States (Edlin, Eckhardt, Shu, Holmberg, & Swan, 2015).

Today, most people contract HCV through sharing needles or equipment to inject drugs with someone who is already infected (Centers for Disease Control and Prevention [CDC], 2016). Another established risk factor is receipt of a blood transfusion before 1992, prior to implementation of screening programs for donated blood (CDC, 2016). Although less frequent, HCV can also be transmitted through other types of blood exposures, like tattooing, during sexual contact, or perinatally from mother to child (CDC, 2016).

National surveillance data indicate that 15% to 20% of persons reported with acute HCV infection have a history of sexual exposure in the absence of other risk factors. However, according to CDC, the science concerning sexual transmission is inconclusive about how frequent sexual transmission occurs. Clearly, sexual transmission of HCV is not efficient among people who are *not* co-infected with HIV or other sexually transmitted infections. CDC reports that the risk of HCV being sexually transmitted increases for those who have multiple sex partners, have a sexually transmitted disease, engage in "rough" sex, or are infected with HIV (CDC, 2015).

Case reports of acute HCV infection among HIV-positive men who have sex with men (MSM) have been reported in New York City (Fierer et al., 2008; Fierer et al., 2012), Boston (Garg et al., 2013; Taylor et al., 2011), and several European cities (Dionne-Odom et al., 2009; van de Laar et al., 2009; Urbanus et al., 2009). These men usually reported engaging in high-risk and traumatic sexual practices, or had co-occurring sexually transmitted diseases (Dionne-Odom et al., 2009; Urbanus et al., 2009). In contrast, a low prevalence (1.5% on average) of HCV infection has been demonstrated in studies of heterosexual long-term spouses of people with chronic HCV infection who had no other risk factors for infection. Overall, these findings indicate that sexual transmission of HCV is possible, but inefficient.

Hepatitis C ranges in severity from mild illness lasting a few weeks to a serious, lifelong illness. As a result, hepatitis C is classified as "acute" or "chronic" depending on the severity and course

of the illness. Acute hepatitis C manifests a few weeks to months after infection, usually within the first six months. Hepatitis C in most people is asymptomatic or is a mild disease, but it can cause severe hepatitis and occasionally even life-threatening liver failure.

The number of acute cases of hepatitis C reported in the United States increased from 1,778 in 2012 to 2,138 in 2013. However, due to underreporting and asymptomatic infections, the Centers for Disease Control and Prevention (CDC) estimate that approximately 29,718 acute cases occurred in 2013 (CDC, 2016).

Approximately 15 to 25% of people infected with HCV will clear the virus (meaning that they are no longer infected), while the remaining 75 to 85% will develop chronic disease. Chronic HCV infection is a long-term disease that may take 20 or more years to become symptomatic. Approximately 60 to 70% of people with chronic infection will develop liver disease. Chronic illness can lead to serious liver complications, like cirrhosis (scarring of the liver) or liver cancer (i.e., hepatocellular carcinoma). Additionally, HCV is the leading reason for liver transplantation in the United States (CDC, 2016, Chapter 3). Hepatitis C also causes disease in many organs outside the liver, including kidney disease, diabetes mellitus, heart disease, skin disease, certain forms of blood cancer (lymphoma) and depression. Total direct medical costs of the non-liver medical conditions are estimated to be $1506 million (range $922-2208 million) (Younossi et al., 2016).

Unfortunately, most people (80%) with acute HCV infection are asymptomatic (CDC, 2016, Chapter 3). If symptoms are present, they progress slowly. Hepatitis C is considered "clinically silent" until late in the disease course. Therefore, in the absence of testing, most people with HCV are unaware of their infections. Indeed, the CDC estimates 45 to 85% of persons with HCV are unaware of their infections, and, therefore, do not benefit from available care and treatment (CDC, 2012).

Recommendations for HCV Screening

HCV testing is recommended for those who:

- Were born from 1945 through 1965 ("Baby Boomers") without ascertainment of risk factors;
- Currently inject drugs;
- Ever injected drugs, even once or a few times many years ago;
- Have certain medical conditions, including people:
    - Who received clotting factor concentrates produced before 1987;
    - Who were ever on long-term hemodialysis;
    - With persistently abnormal alanine aminotransferase levels (ALT); or
    - Who have HIV infection.
- Were prior recipients of transfusions or organ transplants, including people who:
    - Were notified they received blood from a donor who later tested positive for HCV infection; or
    - Received a transfusion of blood, blood components, or an organ transplant before July 1992.

HCV testing based on a recognized exposure is recommended for:

- Health care, emergency medical, and public safety workers after needle sticks, lacerations from sharps or other instruments, or mucosal exposures to HCV-positive blood; or
- Children born to HCV-positive women.

Source: Centers for Disease Control and Prevention: http://www.cdc.gov/hepatitis/hcv/guidelinesc.htm

The United States Preventive Services Task Force (USPSTF) is an independent, volunteer panel of national experts in prevention and evidence-based medicine that makes recommendations about the effectiveness of specific preventive care services for people without related signs or symptoms. The panel is convened by an agency within the U.S. Department of Health and Human Services. The USPSTF gives a "B" grade for hepatitis C testing of populations at high risk for infection and for all adults in the United States born between 1945 and 1965, indicating that testing is recommended for these groups. The B grade ensures that testing is covered by insurance plans with no cost-sharing for the patient.

Population	Recommendation	Grade
Adults at high risk	The USPSTF recommends screening for hepatitis C virus (HCV) infection in persons at high risk for infection. The USPSTF also recommends offering one-time screening for HCV infection to adults born between 1945 and 1965.	B

Source: United States Preventive Services Task Force: http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/hepatitis-c-screening

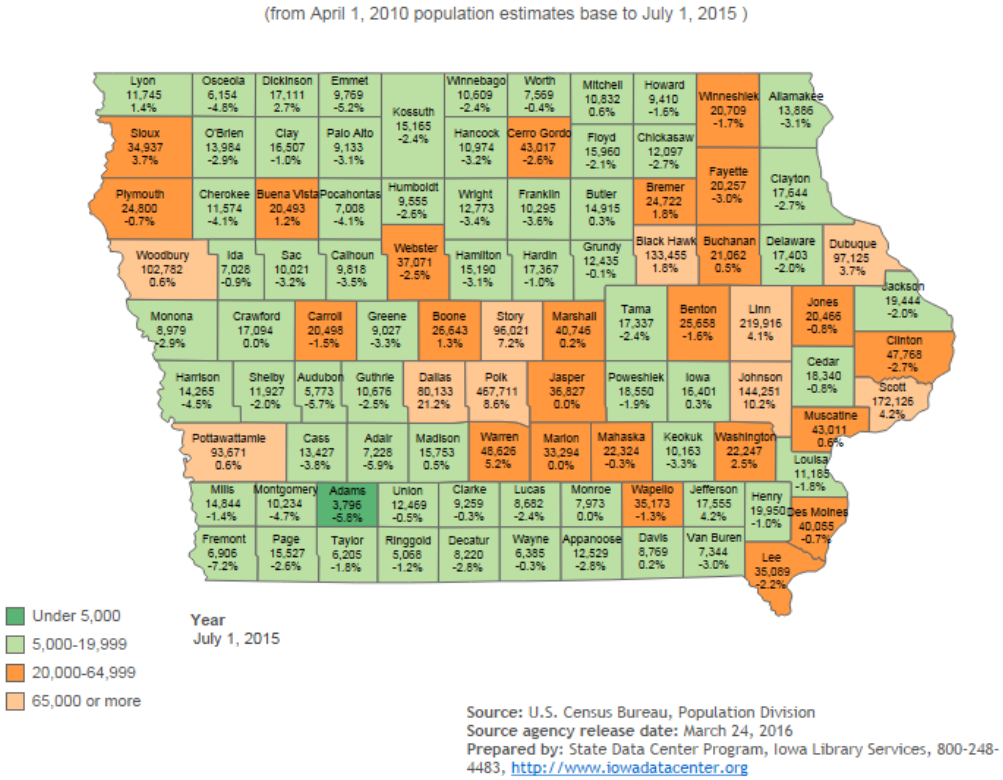
Iowa Socio-Demographic Characteristics

Population Size and Growth

Iowa's 2015 population estimate was 3,123,899, and projected to reach 3,474,647 by 2050. County populations and the percentage population change in each county from 2010 to 2015 is shown in Figure 1. Although Iowa is predominantly rural in terms of land use, the majority of Iowans live in urban locations. More specifically, 64% of Iowans reside in urban areas while 36% of Iowans reside in rural areas.

Iowa is divided into 99 counties, and the largest is Polk County with approximately 15% of the state's total population. Polk also houses the city of Des Moines, Iowa's state capital.

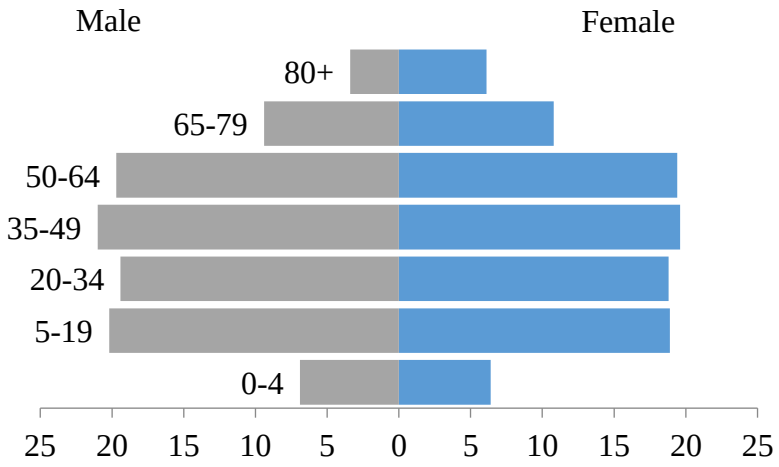
Figure 1: Iowa County Population and Percentage Change, 2010 to 2015



Age and Sex Distribution of Iowa's Population

In 2014, Iowa's age and sex distribution (Figure 2) resembles that of the United States, with females slightly outnumbering males (50.3% to 49.7%). The median age in 2014 was 38.2 years, and has remained virtually constant since 2010 (38.2 years in 2010, with variation of +/ 0.2 between 2010 and 2014).

Figure 2: Iowa Age and Sex Distribution, 2014



Race and Ethnicity

Iowa's 2014 race and ethnicity estimates are shown in Figures 3 and 4, with the majority of the state identifying as White only (87.1%), followed by Hispanic or Latino (5.5%), Black, non-Hispanic (3.1%), Asian (2.2%), two or more races (1.9%), and American Indian or Alaska Native (0.3%).

The U.S. Census Bureau shows an overall growth in minority populations in Iowa from 2010 to 2014. Iowa's Asian population has shown the most growth, increasing by 27% from 2010 to 2014. Other minority populations have grown at similar rates: Native Hawaiian and other Pacific Islanders by 22%, Black, non-Hispanic persons by 16%, and Hispanics by 15%.

Figure 3: Iowa Population by Race, 2014

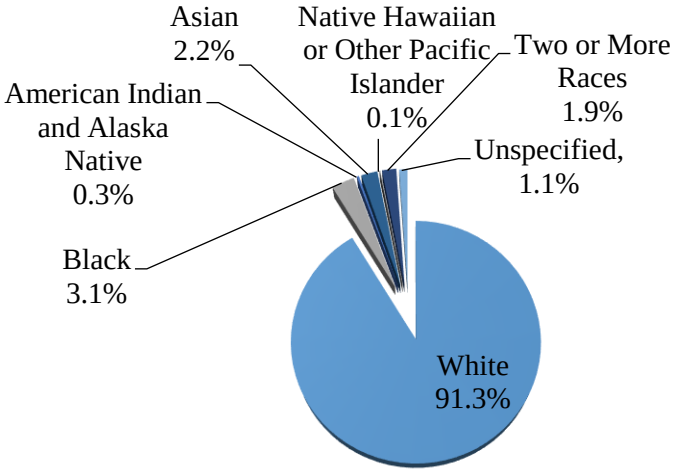
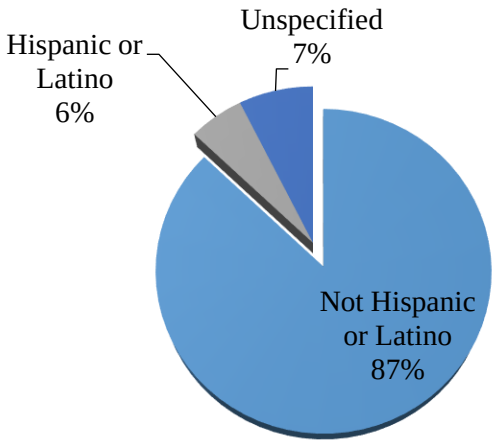


Figure 4: Iowa Population by Ethnicity Status, 2014



Economic Characteristics

The median household income in Iowa in 2014 was $53,712, similar to the United States median income of $53,657 (United States Department of Commerce, 2015). Approximately 12% of Iowans live below poverty level, and Iowa's unemployment rate in 2014 was 4.4%.

It is estimated that almost 92% of Iowans (civilian noninstitutionalized population) have health insurance coverage, with slightly over 75% being covered by private health insurance, and 30.5% covered by public insurance. Approximately 8% of Iowans do not have health insurance coverage, compared to a nationwide estimate of 14.2% (United States Census Bureau, American Community Survey, 2015). In response to provisions in the Patient Protection and Affordable Care Act, Iowa expanded its Medicaid eligibility in January 2014 to include adults with incomes up to 133% Federal Poverty Level (with a 5% income disregard). In April 2016, most Medicaid recipients were transitioned to one of three managed-care organizations.

Reported Cases of Viral Hepatitis C in Iowa

The Iowa Disease Surveillance System (IDSS) enables local public health agencies, hospitals, laboratories, and IDPH to collaborate electronically as they perform disease reporting and surveillance activities across the state. IDSS was first implemented in the Center for Acute Disease Epidemiology (CADE) in October 2008 and is now widely used by hospitals, laboratories, and public health agencies statewide. This system has allowed IDPH to gain a more informed picture of reportable infectious diseases and other conditions that affect the population of Iowa.

Iowa Code 139A and Iowa Administrative Code 641, Chapter 1, govern the reporting of communicable and infectious diseases in Iowa. The statute and regulations require medical providers, blood banks and plasma centers, and laboratorians to report cases and laboratory testing indicative of hepatitis C infection. Acute and chronic cases are reportable, as are positive antibody tests and viral tests, such as viral loads. Positive antibody tests without additional testing do not indicate whether a person is actively infected or had prior exposure and cleared the virus. Approximately 15 to 25% of people with positive antibody tests spontaneously clear the virus without treatment, and may no longer be infected with HCV despite the positive antibody test.

As of March 31, 2016, the number of Iowans who have been reported as being diagnosed with HCV infection was 21,748. Of these, 13,660 had evidence of current infection; that is, they had a confirmatory viral test (e.g., RNA PCR test). The remaining 8,088 people had positive antibody tests, but do not have viral tests reported to confirm the diagnosis. These cases represent people who were actively infected at one point in their lives. According to CDC estimates, 75 to 85% of these people are most likely chronically infected, while 15 to 25% may have cleared the virus spontaneously. This gives a range of 19,726 to 20,535 Iowans reported to IDPH who likely had active HCV infection. Applying CDC's estimate that 45 to 85% of people with hepatitis C are undiagnosed to the number of reported cases would mean that 35,865 to 136,900 Iowans are living with hepatitis C, and that anywhere from 15,330 to 117,174 are undiagnosed (see Appendix for an explanation of how these values were obtained).

The surveillance data indicate that 61.5% of cases were among males, 36.6% were among females, and 1.9% of cases did not have gender reported (Table 1).

Examining racial and ethnic disparities among those living with hepatitis C is extremely difficult given the limitations of the reported data. Race and ethnicity data were not reported for nearly 70% of the cases. Of the population of people for whom race or ethnicity were reported, 82.8% were white; 10.2% were black, non-Hispanic; 3.2% were Hispanic/Latino; 1.7% were Asian, Native Hawaiian, or Other Pacific Islander; 1.7% were American Indian or Alaska Native; and 0.4% were reported as multiple races (Table 1).

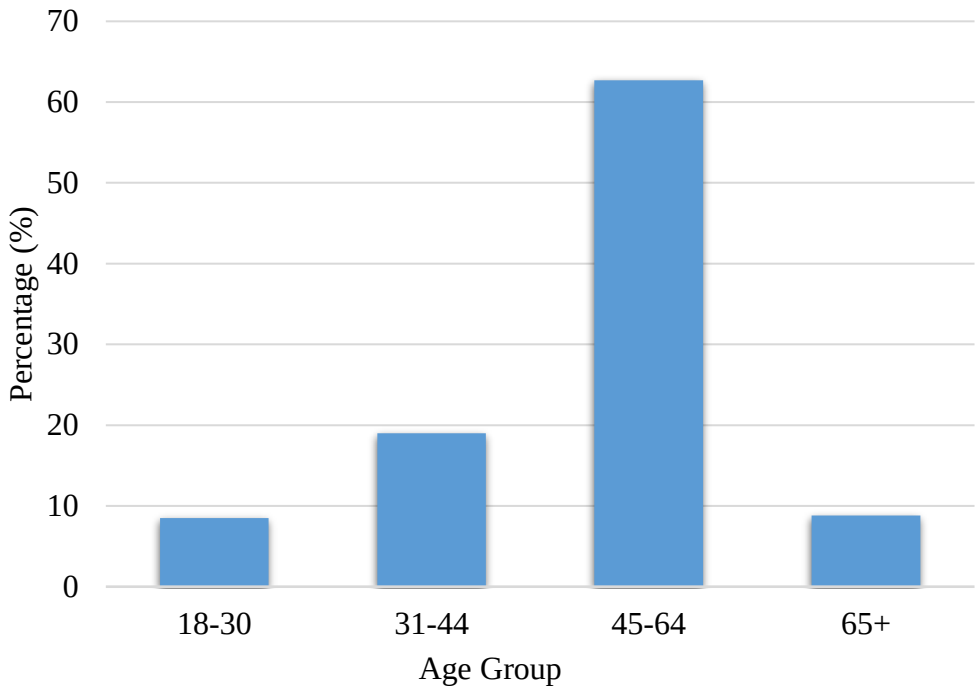
Table 1: Characteristics of People Reported with HCV

	No.	%
Gender		
Male	13,368	61.6
Female	7,964	36.7
Other	416	1.7
Race and Ethnicity*		
White, non-Hispanic	5,741	82.4
Black, non-Hispanic	708	10.5
Latino/Hispanic	223	3.3
American Indian or Alaska Native	118	0.5
Asian, Native Hawaiian or Other Pacific Islander	115	0.6
Multiple Races	25	0.4
Age At Time Of Test		
Median	52.0	
Age Group		
Under 18	191	0.9
18-30	1,857	8.5
31-44	4,138	19.0
45-64	13,639	62.7
65+	1,923	8.8

* Among cases for which it was reported. Race and ethnicity were missing for 14,818 cases.

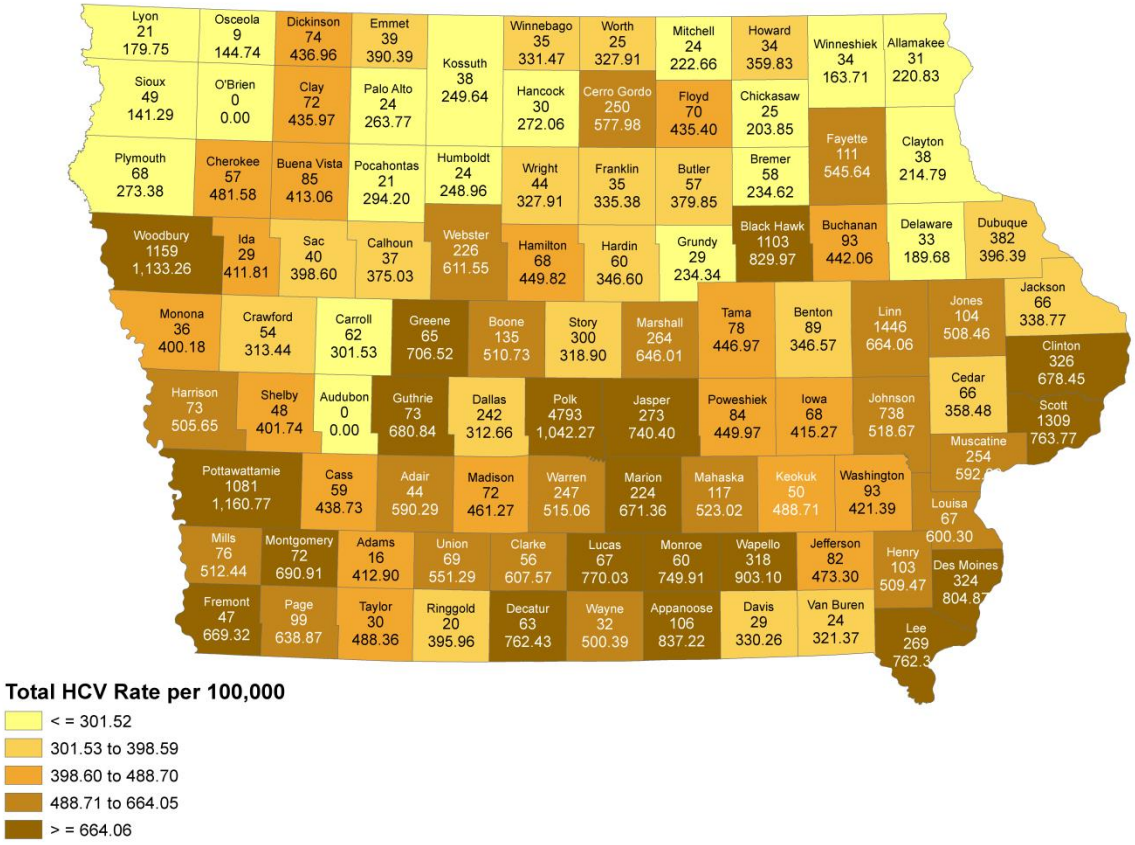
The median age at diagnosis of those reported as HCV positive was 52. Of the 21,748 people reported, 191 (< 1%) were less than 18 years of age at onset of the disease. Data indicate that 8.8% of people diagnosed with HCV were 65 or older, 62.7% were 45 to 64 years of age, 19.0% were 31 to 44 years of age, and 8.5% were 18 to 30 years of age at diagnosis (Figure 5).

Figure 5: Age Distribution of People Living with HCV in Iowa



Over 50% of people living with HCV who were ages 18 to 64 reported residency in one of five counties. These counties were Polk (24.4%), Linn (7.3%), Scott (6.7%), Woodbury (6.1%), and Pottawattamie (5.7%). Figure 6 displays rates of HCV per 100,000 county population. The Iowa counties with the top five highest rates of HCV were Pottawattamie (1,161 per 100,000); Woodbury (1,133 per 100,000); Polk (1,042 per 100,000); Wapello (903 per 100,000); Appanoose (837 per 100,000). Rates of HCV appear to be highest in the south central part of the state.

Figure 6: Counts and Rates of HCV by County of Residence in Iowa



Source: Iowa Disease Surveillance System.

The counts (top value) and rates (bottom value) for each county for Iowans who had been reported to IDPH as having HCV as of March 31, 2016.

Over 53% of the people reported as HCV positive (defined in this analysis as either antibody positive or confirmed positive) had their first test from 2010 to 2015. In 2015, 10.3% of those reported as HCV positive received their first positive HCV antibody or confirmatory test, which was the highest percentage in this analysis. The number of Iowans reported as having HCV positive antibody or confirmatory tests per year has increased between 2000 and 2015. Table 2 shows these trends over time.

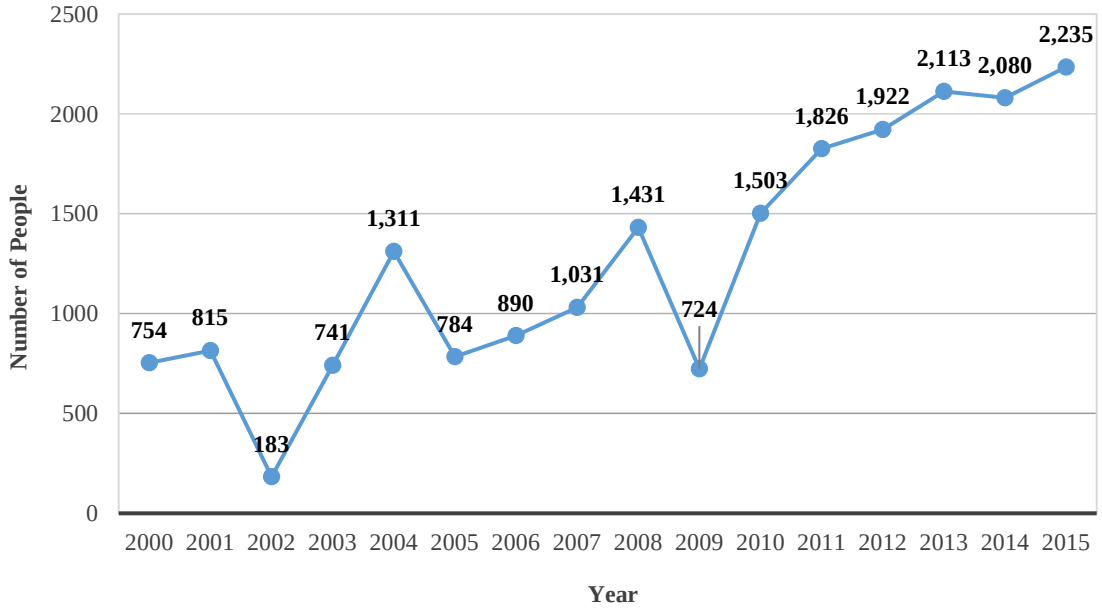
In general, diagnoses have increased each year since 2000. The number of diagnoses in 2015 represents an increase of 196% over that seen in 2000 (Table 2, Figure 7). Diagnoses of people 18 to 30 years of age have increased similarly, the most dramatic increase has occurred since 2009 (Table 2, Figure 8). This represents a 300% increase in diagnoses among those between the ages of 18 and 30.

Table 2: Number of Iowans Reported with Positive HCV Antibody and/or Confirmatory Test per Year

Year	All ages	18 – 30 yrs.
2000	754	5
2001	815	9
2002	183	1
2003	741	22
2004	1,311	26
2005	784	25
2006	890	40
2007	1,031	55
2008	1,431	66
2009	724	73
2010	1,503	103
2011	1,826	195
2012	1,922	236
2013	2,113	301
2014	2,080	279
2015	2,235	303
TOTAL	**20,343**	**1,739**

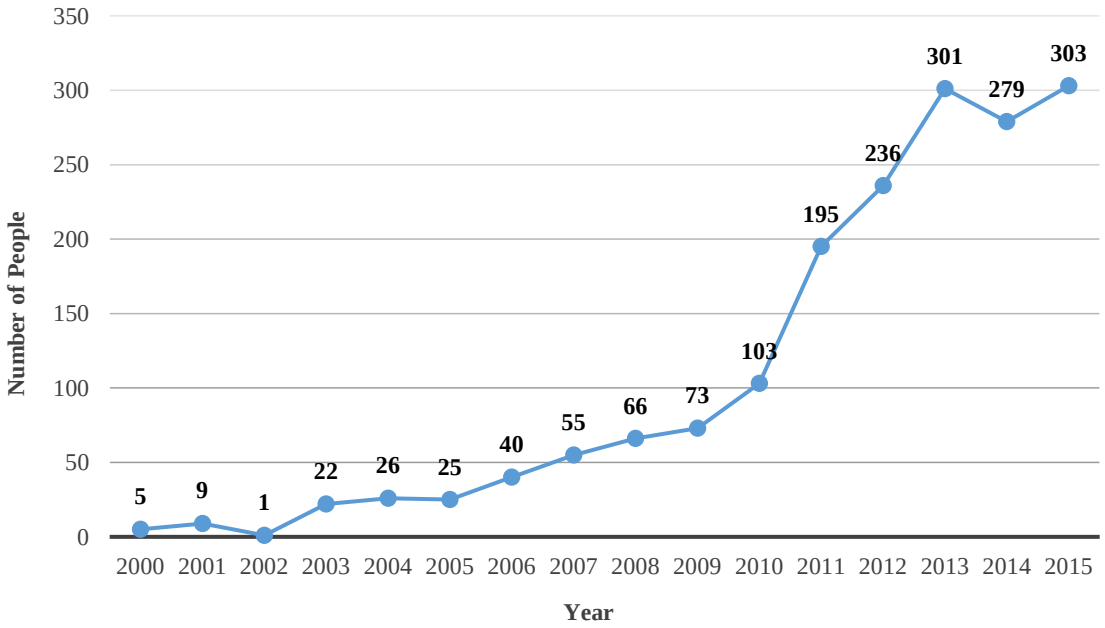
Source: Iowa Disease Surveillance System

Figure 7: Year of First Positive HCV Antibody and/or Confirmatory Test: Total Population



Source: Iowa Disease Surveillance System

Figure 8: Year of First Positive HCV Antibody and/or Confirmatory Test: 18 to 30 Years of Age



Source: Iowa Disease Surveillance System

HCV Surveillance among Persons 30 Years of Age and Under

In the United States, injection drug use (IDU) is the primary risk factor for HCV infection (Centers for Disease Control and Prevention [CDC], 2016). IDU accounts for 68% of all new HCV infections in the United States (CDC, 2016). Roughly 32% of people who inject drugs become infected with HCV within the first year of injecting, and 53% become infected within five years (Hagan et al., 2008).

Increases in HCV infection related to IDU among people less than 30 years of age is a trend that has been reported by CDC in many areas of the country, including the upper Midwest, the Northeast, and Appalachia (CDC, 2015). Much of this increase in injection drug use among youth is related to increases in use of prescription opioids and heroin. Increases in diagnoses of HCV among specific populations can be an early warning sign that injection drug use is increasing in that population.

In Iowa, rates of heroin and opioid-related overdoses have increased greatly over the last 10 years. Emergency department (ED) visits related to opioid overdoses have increased by roughly 253%, and ED visits from heroin increased by 2,500% from 2003 through 2014 for individuals under 35 years of age (IDPH, 2016). More information on this is provided later in the profile.

In 2015, IDPH began conducting active surveillance of Iowans 30 years of age or younger who were diagnosed with HCV infection to monitor trends more closely and determine the severity of the problem in Iowa. This involved calling providers to gather more complete information about the patient, including whether injection drug use was reported by the patient to the provider. IDPH analyzed data on 287 HCV cases reported in 2015 where the person diagnosed was 30 years of age or younger. Approximately 52% of those cases were among males, and 48% were among females (Table 3). This was different from the overall population of people reported with HCV in Iowa, in which nearly 62% of cases were among males (Figure 9).

Among those reported with HCV who were 30 years of age and younger, 86% identified as White, non-Hispanic, 5% were Black, non-Hispanic, 4.2% were Hispanic, 2.5% were either Asian, Native Hawaiian or Other Pacific Islander, 0.70% American Indian or Alaska Native, and less than 1% identified as multiple races. Race and ethnicity data were not available for 59% of the population in this dataset (Table 3). The average age of those identified with HCV infection at 30 years of age or under at the time of diagnosis was 25.

Table 3: Characteristics of People 30 or Younger who are Living with HCV

	No.	%
Gender		
Male	148	51.6
Female	139	48.4
Race/Ethnicity*		
White, non-Hispanic	102	85.7
Black, non-Hispanic	6	5.0
Latino/Hispanic	5	4.2
American Indian or Alaska Native	2	0.7
Asian, Native Hawaiian or Other Pacific Islander	3	2.5
Multiple Races	1	0.8
Age At Time Of Test		
Median	25	
Injection Drug Use (n=287)		
No	81	38.9
Yes	114	54.8
Unknown	13	6.3

* Among cases for which race and ethnicity were reported. Race and ethnicity data were missing for 168 case reports.

Of the 303 people age 30 and under reported to IDPH as being HCV-positive in 2015, data on injection drug use was collected for 69% (208) of them by calling health care providers. Among those, 55% of people reported injection drug use, 39% reported no injection drug use, and use of injection drugs was unknown by providers for 6% (Table 3, Figure 10). Over 50% of the people who were under 30 years of age and living with HCV reported residency in six primary counties. These counties were Polk (28%), Linn (7.2%), Scott (7.0%), Woodbury (5.4%), Pottawattamie (4.7%), and Black Hawk (4.6%). Rates of HCV per 100,000 population among this group were highest in south central Iowa, including the counties of Adair (356 per 100,000), Guthrie (281

per 100,000), Appanoose (273 per 100,000), Polk (254 per 100,000), and Marion (248 per 100,000) (Figure 11).

Figure 9: Sex of People Living with HCV (1999 to 2015) Compared to People under 30 Years of Age with HCV Reported in 2015

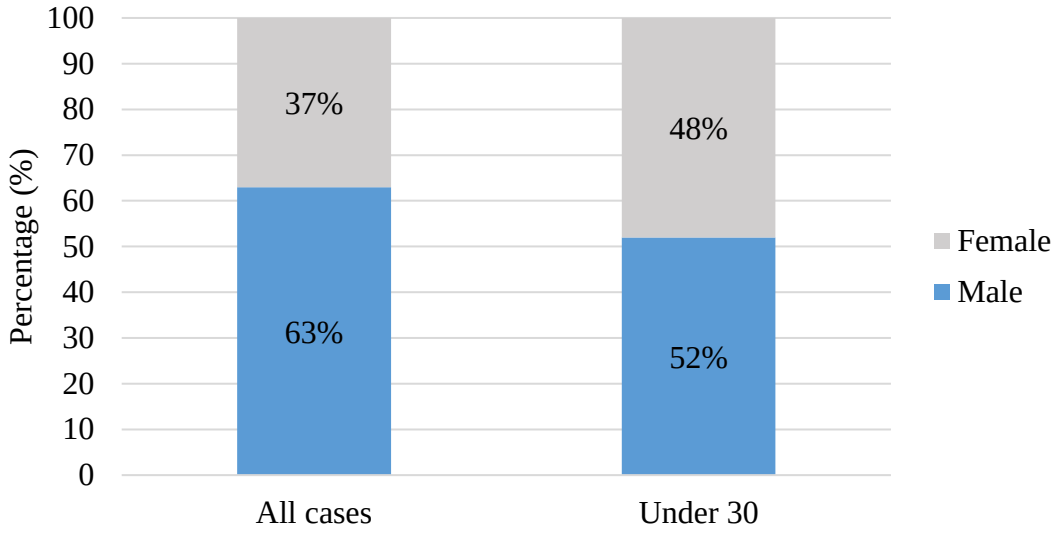


Figure 10: Injection Drug Use Among People Living with HCV who are 30 Years of Age or Younger

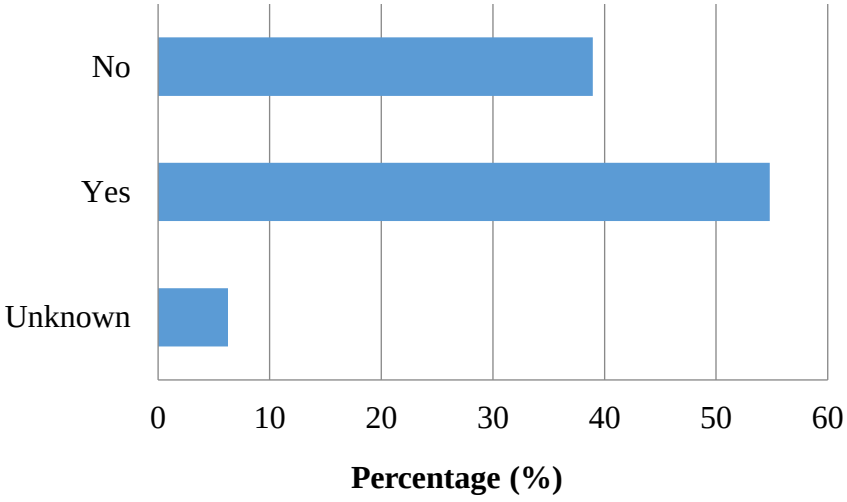
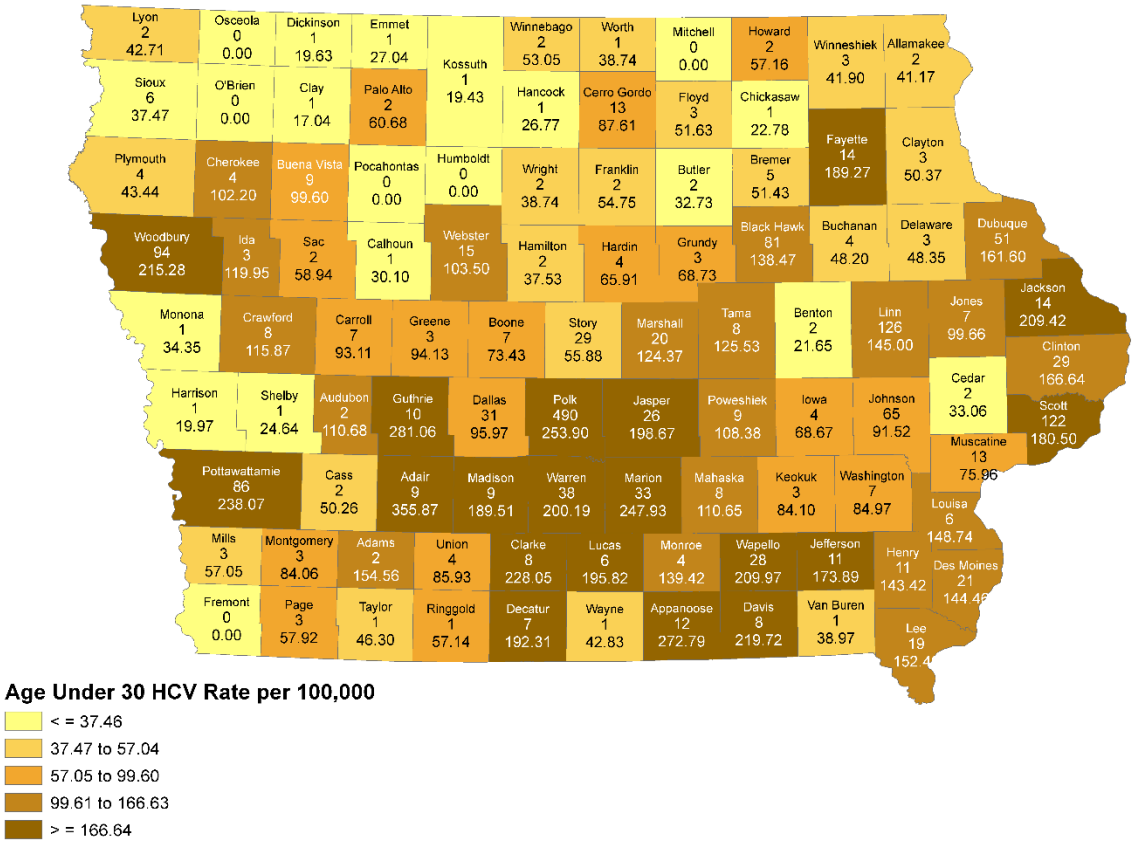


Figure 11: Counts and Rate of Iowans 30 years of Age or Younger Reported with HCV in Iowa Counties



Source: Iowa Disease Surveillance System.

The whole number values in each county represent the counts of Iowans living with HCV who were 30 years of age or younger and residing in the county at time of diagnosis. The bottom values represent the rate of HCV per 100,000 population.

HEPATITIS C-RELATED HOSPITALIZATIONS

This section emphasizes the number of hospitalizations related to HCV infection, both nationally and within Iowa.

The chronic nature of HCV can result in hospitalization in both inpatient and outpatient settings. The hospitalization rate has been steadily increasing for people with HCV from 1996 to 2010 in the U.S. (Oramasionwu et al., 2014). National estimates highlight that the baby boomer population (those born between 1945 and 1965) accounted for approximately 70% of both inpatient and outpatient discharges among people with HCV between 2001 and 2010 (Galbraith et al., 2014).

Inpatient and outpatient hospital data from the IDPH Tracking Portal were analyzed to identify hospitalizations that were related to hepatitis C infection. HCV-related hospitalizations were identified by records in which HCV was included as a diagnosis code for the hospitalization (inpatient and outpatient). Note that the numbers in this section refer to hospitalization events, and that individual people can have multiple hospitalization events within the same year. Both 'Emergency Department Visits' and 'Inpatient Visits' sections of this profile primarily focus on visits where HCV was the primary diagnosis.

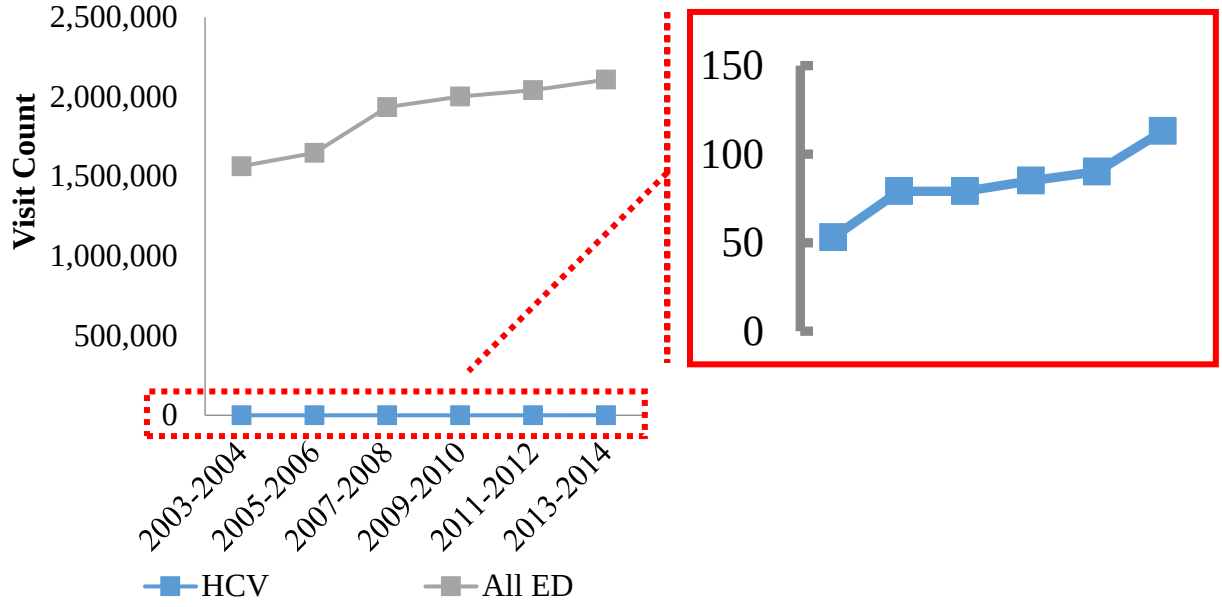
Emergency Department Visits

In 2014, there were 1,092,609 emergency department visits to hospitals in Iowa, and 54 of those included HCV as the primary diagnosis. Figure 12 shows emergency department (ED) visit counts for 2003 through 2014. While overall ED visit counts increased by 35% during these years, HCV ED visits increased by 93%.

Males in Iowa have more HCV ED visits than females (Figure 13). The ratio of male to female visits has remained approximately constant at 1.5 to 1 over the last 5 years.

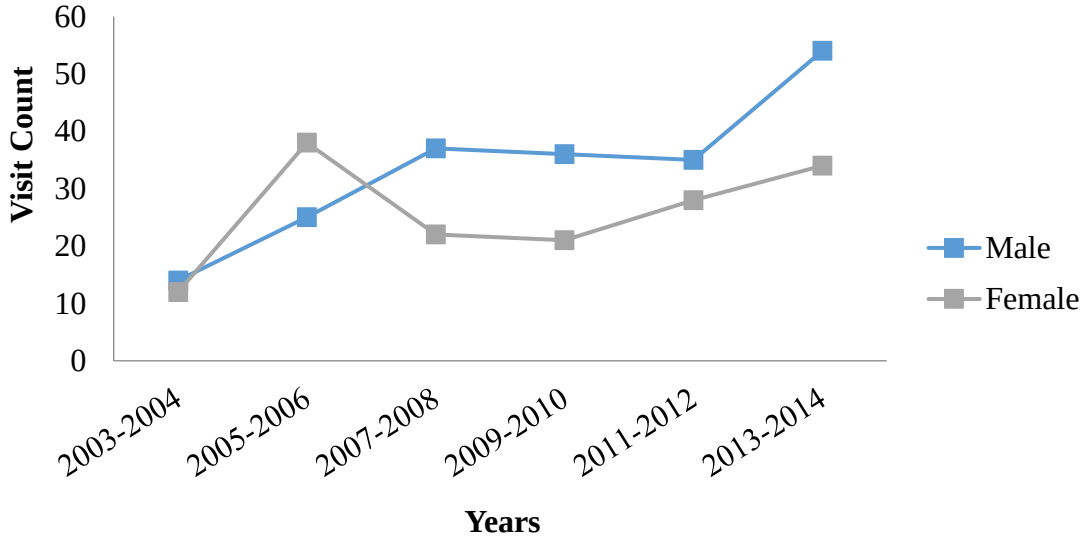
From 2003 through 2014, adults aged 35 to 64 years accounted for 30% of all ED visits in Iowa (data not shown pictorially). In comparison, 83% of all HCV ED visits were among adults between the ages of 35 to 64 years of age (Figure 14).

Figure 12: Emergency Department Visit Count, Iowa, 2003-2014



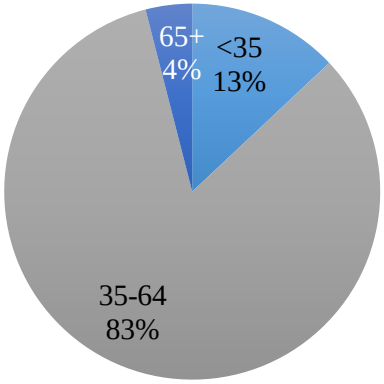
Source: IDPH, Iowa Public Health Tracking Portal
Note: HCV visit is defined as having any of the following ICD-9 codes within the emergency department primary diagnosis code: 70.41, 70.44, 70.51, 70.54, 70.7, and 70.71. HCV-related visit counts are magnified (see boxed red outline) and shown on a different scale.

Figure 13: HCV ED Visit Count by Sex, Iowa



Source: IDPH, Iowa Public Health Tracking Portal

Figure 14: Percentage of total HCV ED Visits by Age, Iowa, 2003-2014

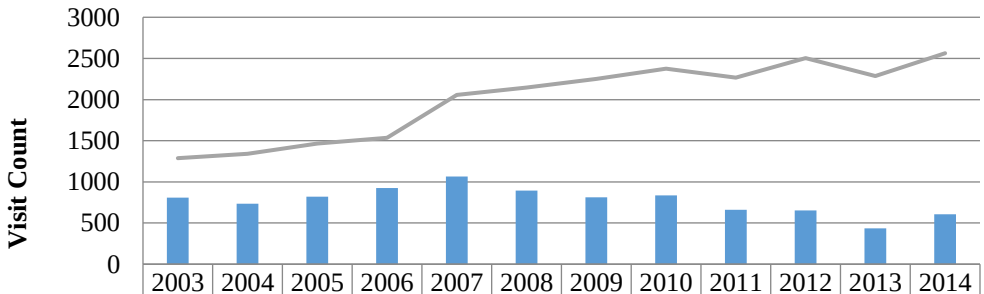


Source: IDPH, Iowa Public Health Tracking Portal

Inpatient Visits

In 2014, there were 317,741 total inpatient visits in Iowa. Of those visits, 2,563 (0.81%) of the records had hepatitis C listed as any diagnosis code, 606 (0.19%) listed HCV as the primary, secondary, or tertiary diagnosis, and 109 listed HCV as a primary diagnosis (based on any of the following ICD-9 codes: 70.41, 70.44, 70.51, 70.54, 70.7, and 70.71, see Figure 15). In addition, individuals 35 to 64 years old accounted for nearly 85% of all HCV hospitalizations between 2000 and 2014.The mean length of stay for HCV visits in Iowa was 5.07 days in 2014, which is above the mean length of stay for all inpatient hospitalizations in 2014 by 0.7 days. Of the 109 inpatient hospitalizations in 2014 where HCV was listed as the primary diagnosis, Medicaid and Medicare (non-managed care) accounted for over 50% of listed payment sources (Figure 16).

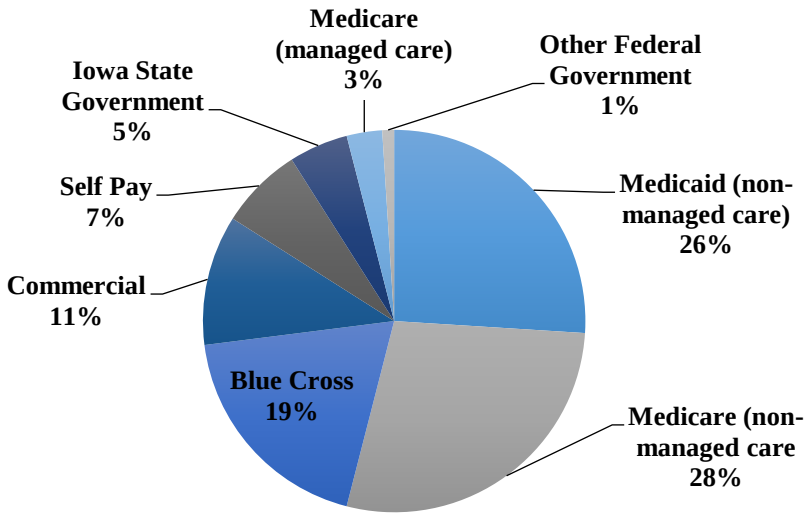
Figure 15: HCV-Related Diagnosis Inpatient Visit Count, Iowa, 2003-2014



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Primary, Secondary, and Tertiary	808	736	820	924	1066	895	812	835	662	652	437	606
Any	1288	1341	1464	1536	2055	2146	2250	2376	2267	2503	2285	2563

Note: Hepatitis C ICD-9 codes included 70.41, 70.44, 70.51, 70.54, 70.7, and 70.71

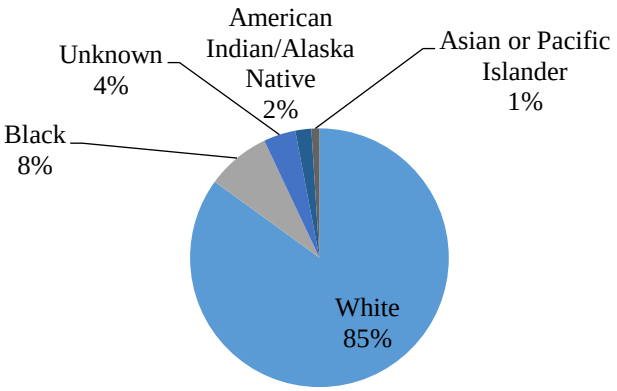
Figure 16: Payment Source for HCV Inpatient Hospitalizations, Iowa, 2014



Source: IDPH, Iowa Public Health Tracking Portal

Figure 17 shows HCV inpatient hospitalizations by race and ethnicity in 2014. Blacks/African Americans account for 8% of all HCV inpatient visits (Figure 16). However, Blacks/African Americans make up 10% of the Iowa's HCV population. Therefore, their hospitalization rate is slightly lower than expected. Conversely, American Indians and Alaskan Natives bear a disproportionate burden, as they account for 2% of all HCV inpatient visits, but make up only 0.52% of Iowa's HCV population.

Figure 17: HCV Inpatient Visit by Race Percentage of Total, Iowa, 2014



Note: Ethnicity status was not available for these data.

The most common diagnoses associated with HCV inpatient hospitalizations in Iowa were respiratory system diseases (35.7%), followed by mental disorders (Table 4). Together these primary diagnosis groups account for nearly 60% of all inpatient visits where HCV was listed anywhere as an additional diagnosis. Other diagnoses associated with these visits were unspecified septicemia, alcohol withdrawal, pneumonia, acute renal failure, and acute pancreatitis (Table 5).

Table 4: Diagnostic Categories of Inpatient Visits with HCV, Iowa, 2014

Rank	**%**
1. Respiratory System	36
2. Mental Disorders	24
3. Digestive System	18
4. Infectious and Parasitic Diseases	12
5. Circulatory System	8

Source: IDPH, Iowa Public Health Tracking Portal

Table 5: Top 5 Primary Admittance Diagnoses of Hospitalization with HCV, Iowa, 2014

Rank	**ICD-9 Code**	**ICD-9 Description**	**Count**
1	38.9	Unspecified septicemia	78
2	291.81	Alcohol withdrawal	72
3	486	Pneumonia, organism unspecified	61
4	584.9	Acute renal failure, unspecified	47
5	577	Acute pancreatitis	44

Source: IDPH, Iowa Public Health Tracking Portal

Liver Cancer

National Perspective

HCV is a major risk for the development of hepatocellular carcinoma (HCC), also called liver cancer. Less than 18% of individuals with liver cancer survive five years or more following diagnosis (National Cancer Institute [NCI], 2016).

Liver cancer incidence in the United States has more than tripled since 1980 (American Cancer Society [ACS], 2016). Moreover, liver cancer deaths in the U.S. increased at the highest rate among common cancers for both men and women from 1975 to 2012 (NCI, 2016).

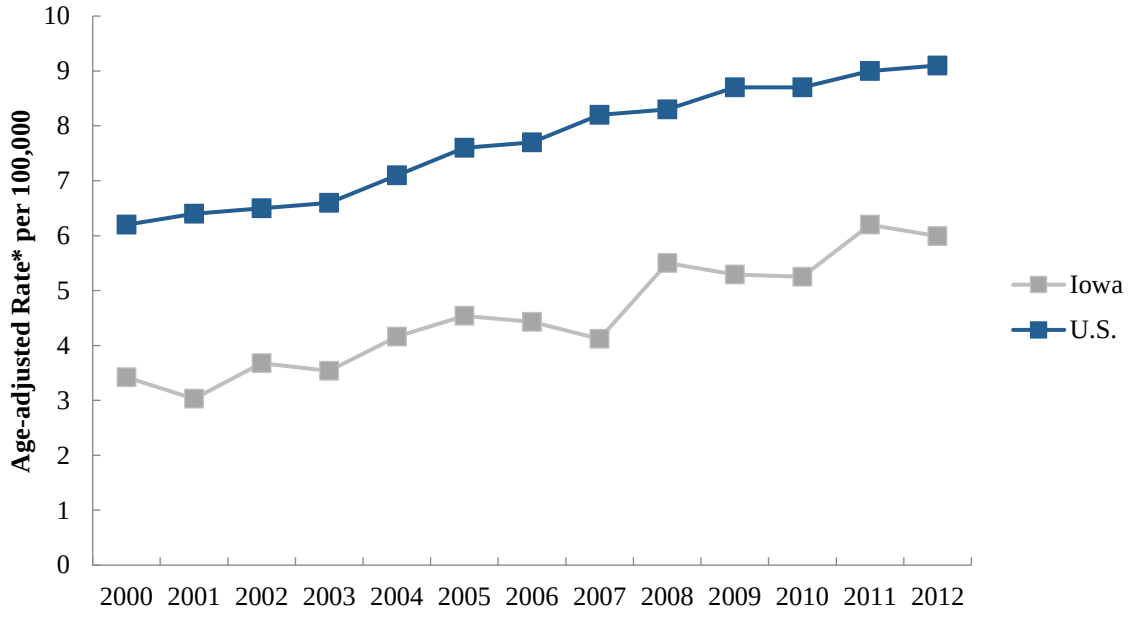
Although liver cancer deaths are increasing for both sexes nationally, males are more than twice as likely as females to die from liver and intrahepatic bile duct cancer (Ryerson et al., 2016). Males are also about three times as likely as females to develop these cancers.

It should be noted that HBV (hepatitis B virus) infection also increases the risk for liver cancer, and contributes to the overall rate. Fortunately, rates of HBV infection have demonstrated a global decline due to increased rates of HBV vaccination of children at birth.

Iowa-Specific Data

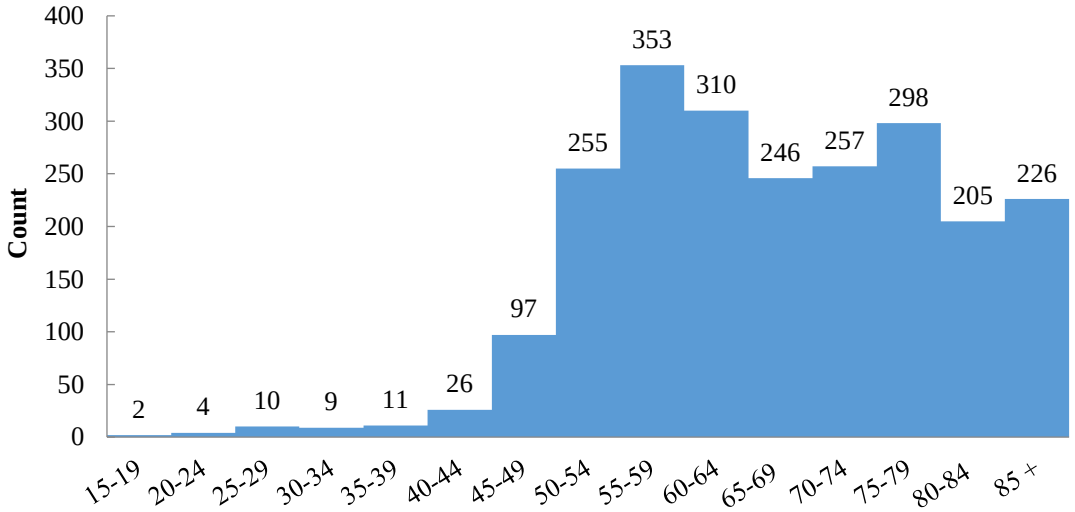
Iowa, like the rest of the nation, is experiencing increasing liver and intrahepatic bile duct cancer mortality and incidence rates. Iowa's liver and intrahepatic bile duct cancer mortality rate has increased at an average of 4% each year from 2000 to 2012. Incidence rates (i.e., new diagnoses) have increased at an average of 5.6% from 2000 to 2012 (Figure 18), which is higher than the national average of 2.6% (NCI, 2016), but Iowa's overall rate remains well below the national rate. In Iowa, diagnoses increase substantially after age 49, and reach a peak among those aged 55 to 59 (Figure 19).

Figure 18: Liver and Intrahepatic Bile Duct Cancer Incidence, Iowa and U.S. Comparison, 2000 – 2012



Source: Iowa Cancer Registry, State Health Registry of Iowa. Based upon data released August 2015. http://cancer-rates.info/ia/

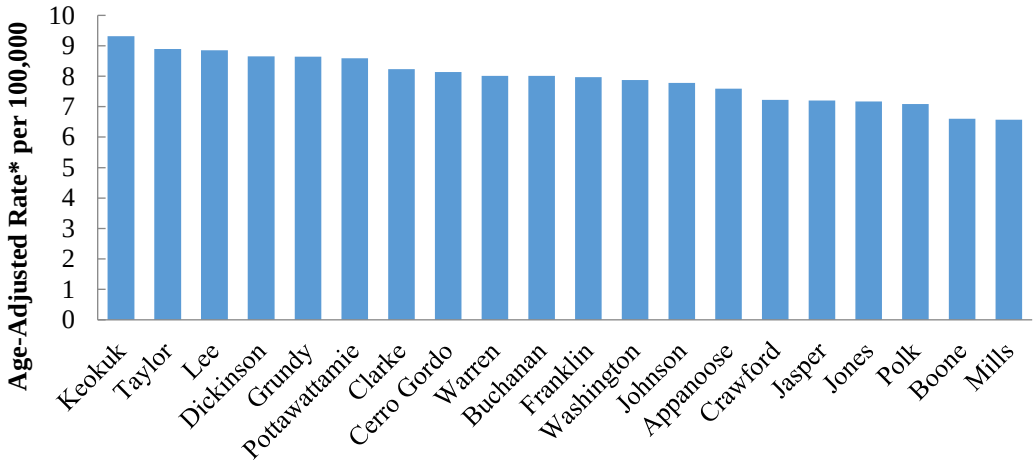
Figure 19: Liver and Intrahepatic Bile Duct Cancer Cases by Age, 2000 – 2012



Source: Iowa Cancer Registry, State Health Registry of Iowa. Based on data released August 2015. http://cancer-rates.info/ia/

The top 20 counties for highest liver and intrahepatic bile duct cancer incidence rates over 2008-2012 are shown in Figure 20. Incidence rates between 2008 and 2012 were averaged due to the instability of rates when broken down at the county level. Keokuk County has the highest average rate at 9.32 per 100,000 (95% confidence interval (CI): 3.19, 21.56) per 100,000, nearly twice that of the statewide average (5.65 per 100,000; 95% CI: 5.31, 6.01).

Figure 20: Top 20 Iowa Counties, Average Incidence Rate for Liver and Intrahepatic Bile Duct Cancer Cases, 2008-2012

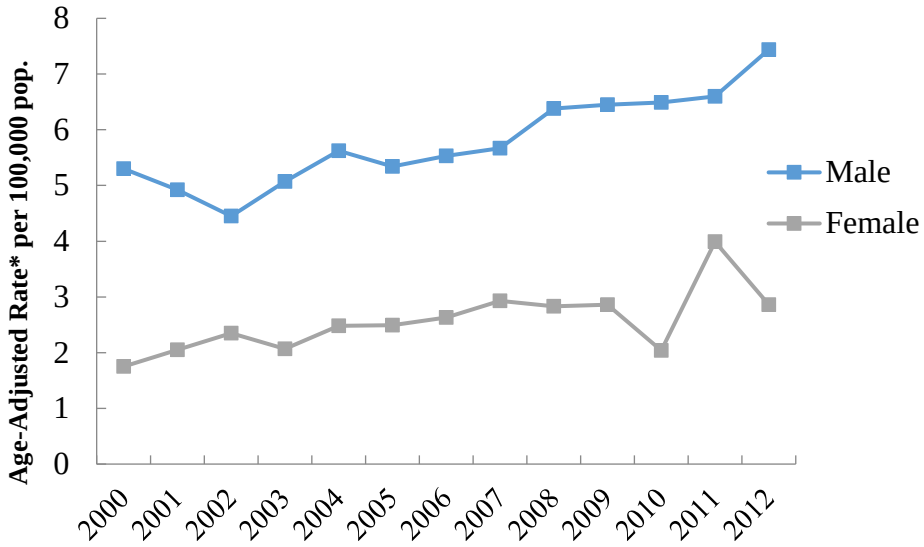


Source: Iowa Cancer Registry, State Health Registry of Iowa. Based upon data released August 2015. http://cancer-rates.info/ia/. Age-adjusted cancer incidence rates were averaged across 2000-2012 and the top 20 counties were selected for visualization. Note: all counties shown have rates higher than the statewide average age-adjusted rate between 2000-2014 (5.65 per 100,000).

There are significant differences in mortality rates between males and females for liver and intrahepatic bile duct cancers within the Iowa (Figure 21), with males bearing a much heavier burden. Liver cancer is listed in the top 10 cancer deaths among Iowa males in 2016, but not among females (University of Iowa State Health Registry, 2016). Additionally, Iowa's gender-stratified liver incidence trends for these cancers are similar to the national trend, with rates among males approximately three times higher than that of females.

Due to low counts among racial and ethnic groups in the state of Iowa, it was not possible to illustrate stable trend rates among these populations.

Figure 21: Liver and Intrahepatic Bile Duct Cancer Mortality in Iowa, 2000 – 2012



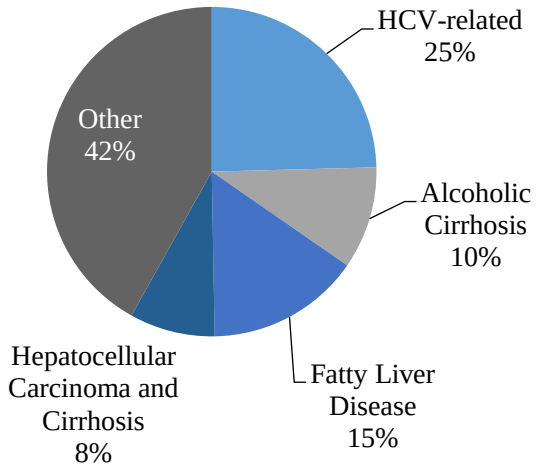
Source: Iowa Cancer Registry, State Health Registry of Iowa. Based on data released August 2015.
http://cancer-rates.info/ia/

Liver Transplants

HCV infection is an established risk factor for liver cancer and cirrhosis. For every 100 persons infected, approximately 5 to 20 will develop cirrhosis over a period of 20 to 30 years, and 1 to 5 will die from the consequences of chronic infection, either liver cancer or cirrhosis (CDC, 2016). The most common reason for liver transplant in U.S. adults is cirrhosis caused by chronic hepatitis C infection, followed by cirrhosis caused by long-term alcohol abuse (CDC, 2016; NIDDK, 2012).

Of all the organ transplants that occurred in Iowa from 2000 to 2015, liver transplants made up an average of 15% across those years, as documented by the United Network of Organ Sharing (UNOS). Of all liver transplants from 2000 through 2015, approximately 25% were HCV-related, with alcoholic cirrhosis following at 15% (Figure 22, HCV-related defined by Gasiorowicz et al., 2006).

Figure 22: Liver Transplants in Iowa by Patient Diagnosis, 2000 - 2015



Source: Organ Procurement and Transplantation Network, data pulled in April 2016
Note: HCV-related included diagnoses of Acute Hepatitis Necrosis: Type C Cirrhosis Type C; Cirrhosis Types B and C; Cirrhosis; Chronic Active Hepatitis: Etiology Unknown; and Alcoholic Cirrhosis with Hepatitis C (Gasiorowicz et al., 2006).

Since 2000, there has been a slight decrease in the number of HCV-related liver transplants occurring at Iowa transplant facilities (Figure 23). This recent decline could reflect limited availability of organs, or the improved treatments available for HCV infection. Other common transplant facilities for Iowa residents include the University of Nebraska Medical Center in

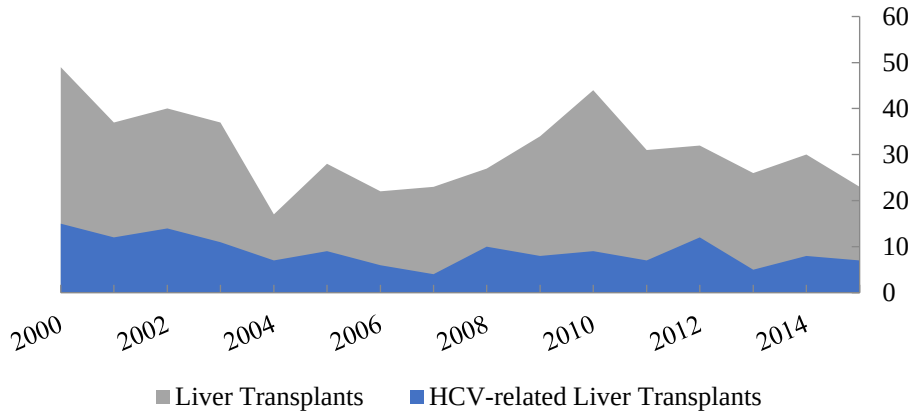
Omaha and the Mayo Clinic in Rochester, Minnesota. A total of 618 people reporting an Iowa residence have received a liver transplant since 2004 (Table 6).

Table 6: Nationwide Liver Transplants among Patients with an Iowa Residence

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
33	55	55	40	46	65	63	56	53	53	50	49

Source: Organ Procurement and Transplantation Network as of November 14, 2016

Figure 23: Liver Transplants at Iowa Facilities, 2000 - 2015



Source: Organ Procurement and Transplantation Network, April 2016. Note that these are transplants that occurred at Iowa facilities, and do not account for transplants that Iowans received at out-of-state facilities.

Additionally, liver transplantation is a considerable burden in health care costs. The estimated U.S. average cost per liver transplant is $739,100 (Table 7 by KIDDK, 2012). In Iowa, 48 HCV-related liver transplants have occurred since 2010. If these transplants were charged at the U.S. average total billing cost, an estimated $35,477,000 would have been spent on HCV-related liver transplants since 2010.

Table 7: Estimated Average Billed Charges per Liver Transplant in U.S.

Liver, U.S. Estimated Average Billed Charges per Transplant	*Cost, US $*
30 days Pre-transplant	$37,300
Procurement	$95,000
Hospital Transplant Admission	$399,100
Physician During Transplant	$53,100
180 Days Post-transplant Discharge	$128,900
OP Immunosuppressants and Other Rx	$25,700
Total	$739,100

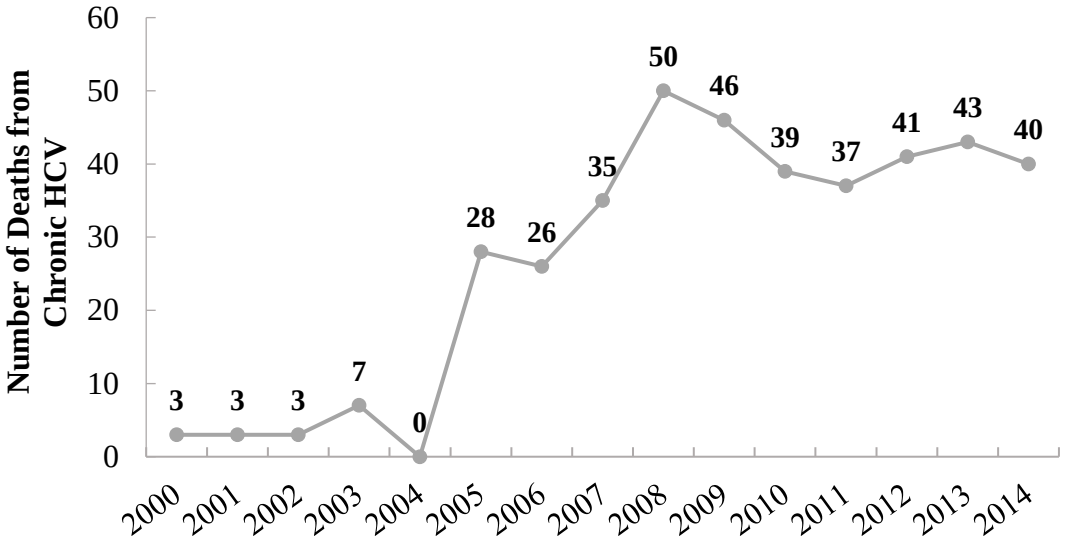
The prevalence of more advanced liver disease is expected to increase, as well as the total cost associated with chronic HCV infection. Today, the total cost is estimated at $6.5 ($4.3-$8.4) billion and it will peak in 2024 at $9.1 ($6.4-$13.3) billion (Razavi et al., 2013).

Hepatitis C Mortality

Nationally, death certificate data indicate that hepatitis C virus is the most common infectious cause of death, exceeding 60 other infectious diseases combined, including HIV, hepatitis B, and tuberculosis (Ly et al., 2016). In 2013, there were 19,368 death certificates that listed HCV as a primary or contributing cause of death in the United States (CDC, 2015). It is thought that mortality from hepatitis C is likely underestimated, as estimates of hepatitis C mortality use death certificate data, which often underreport HCV infection.

For the purposes of this report, an HCV-related death is one in which HCV was indicated as the primary cause of death designated by the clinician, medical examiner, or coroner on the death certificate. Between 2000 and 2014, there were 401 deaths in Iowa in which chronic HCV was listed as the primary cause of death (Figure 24).

Figure 24: Deaths with Chronic Viral Hepatitis C Listed as Primary Cause of Death in Iowa, 2000 – 2014



Source: Iowa Department of Public Health Vital Statistics

Special Populations and Hepatitis C Virus

HCV and HIV Co-Infection

In the United States, it is estimated that 25% of persons living with HIV are co-infected with hepatitis C (Centers for Disease Control and Prevention, 2015). Co-infection with HIV and HCV is particularly common (50 to 90%) among people living with HIV who inject drugs. HCV infection progresses more rapidly to liver damage in persons living with HIV. Additionally, HCV infection may impact the management of HIV infection (CDC, 2015).

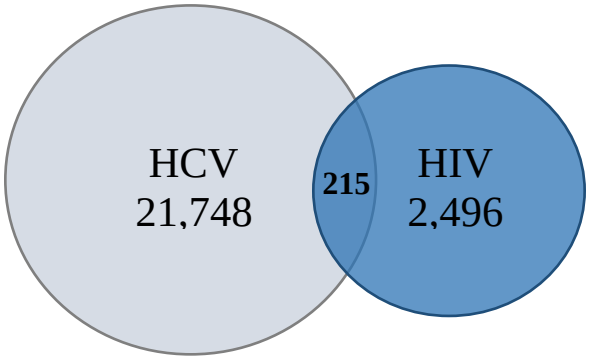
Iowa is considered to be a low-prevalence state for HIV disease. At the end of 2015, there were an estimated 2,922 persons living with HIV in Iowa. During 2015, there were 124 people diagnosed with HIV while living in Iowa. The five-year average of diagnoses from 2010 through 2014 was 114. Males typically account for 80% or more of the diagnoses in Iowa. People 25 to 44 years of age usually make up approximately half of all HIV diagnoses. Regarding HIV exposure category, people who inject drugs accounted for 8% of diagnoses in 2014 and 2015. The five-year average from 2010 to 2014 was 6%. The largest proportion (approximately two-thirds) of HIV diagnoses in Iowa is among white, non-Hispanic persons. HIV diagnoses among black, non-Hispanic persons average around 20% of diagnoses per year.

Demographics of Co-Infected Persons

To ascertain co-infections of HIV and HCV in Iowans, HIV cases in the HIV surveillance system (eHARS; [n=2,496]) were matched with the HCV surveillance system (IDSS) through 2015. These data were supplemented by data from three Ryan White-funded HIV clinics in Iowa. A total of 215 persons (approximately 9% of people living with HIV) were identified as being co-infected with HIV and HCV. This is likely to be an underestimate, as 50% of the people with HCV and HIV co-infection had not been previously reported to the HCV surveillance system. A survey of other HIV clinics in the state would likely yield more diagnosed cases of co-infection.

Of those co-infected people, 62% were age 45 or older at the time of hepatitis C diagnosis. In addition, 79% were male and 21% were female. Most cases of HCV (65%) were among white, non-Hispanic persons, while 22% were among black, non-Hispanic persons. As of December 2015, approximately 12% of the co-infected people were deceased.

Figure 25: Overlap of HCV and HIV Infection in Iowa

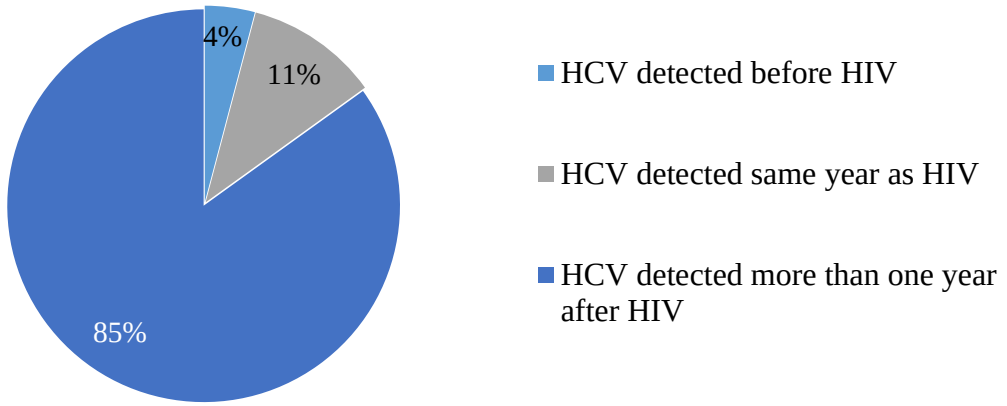


Source: Iowa Disease Surveillance System and Enhanced HIV/AIDS Reporting System

Timing of Detection

The Centers for Disease Control and Prevention recommend that all persons with HIV infection be screened for hepatitis C virus. Determining the timing of infection is particularly important for the identification of outbreaks. The state of Indiana experienced an outbreak of HIV in 2015 among people who inject drugs in a rural area of the state where very few HIV cases (fewer than five) were typically reported (CDC, 2015). An investigation of the 169 HIV-positive people revealed that 86% of them were co-infected with HCV (Indiana State Dept. of Health, 2015). In people co-infected with HIV and HCV living in Iowa for whom data were available (n=208), HCV infection was detected more than one year after HIV diagnosis in 73% of co-infected people, and detected within one year of HIV diagnosis in 24% of people (Figure 26).

Figure 26: Timing of HCV Detection Relative to HIV Diagnosis



Source: Iowa Disease Surveillance System and Enhanced HIV/AIDS Reporting System

Counseling, Testing, and Referral Data

The Iowa Department of Public Health receives state funding to administer viral hepatitis prevention services. As of December 2015, there were seven local health departments and one Federally Qualified Health Center (FQHC) that administer HCV testing and hepatitis A and B immunizations. These agencies, known as Counseling, Testing, and Referral (CTR) sites, are located in the most populous counties of Iowa. HCV testing is offered free-of-charge to people who report having ever injected drugs. The test is a 20-minute rapid antibody test. People who test antibody-positive undergo a blood draw, which is sent to a laboratory to conduct RNA confirmatory testing. Although most testing occurs within the health department or FQHC clinic, the CTR sites also conduct outreach testing at substance abuse facilities and county jails. The CTR sites only test people who report ever having injected drugs, as these people are at increased risk of transmitting the virus to others who may share injection equipment.

From 2011 to 2015, the CTR sites administered 2,391 HCV tests (Figure 27a). The average positivity of HCV antibodies for the years 2011 to 2015 was 11.9% (285 HCV cases identified by the CTR sites). The CTR sites in 2013 saw the highest positivity at 14.3%, while 2014 saw the lowest positivity at 9.9%. The positivity was 10.6% in 2015. The CTR sites reported that roughly 47% or 1,134 HCV tests (Figure 27b) were among those age 30 and under. The average positivity of HCV antibodies for age 30 and under for the years 2011 to 2015 was 8.6% (97 HCV cases identified by the CTR sites). The CTR sites in 2013 saw the highest positivity at 11.2%, while 2014 saw the lowest positivity at 5.7%. The positivity was 9.9% in 2015, which is higher than the five-year average.

Approximately 60% of those testing positive for HCV were male (Table 8). Of the population of people identified as HCV positive, 83.5% were White and non-Hispanic, 7.4% were Black and non-Hispanic, 4.2% were Hispanic, 2.5% were American Indian or Alaska Native, 1.1% were either Asian, Native Hawaiian or Other Pacific Islander, and 1.4% identified multiple races (Table 7). The median age of those identified as HCV positive by the CTR sites was 36. Among those with HCV age 30 and under, 3.1% were Black, non-Hispanic, and 7.2% were Hispanic (Table 8).

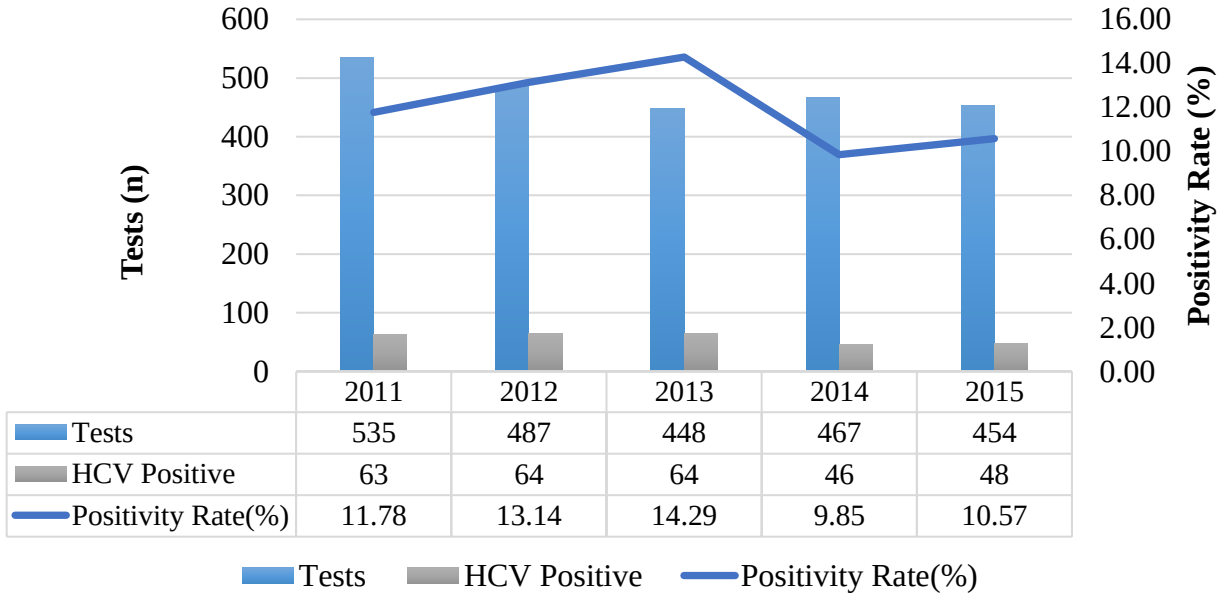
Self-reported residence was also collected. Over 70% of the people who tested HCV positive at the CTR sites lived in one of five Iowa counties. These counties were Polk (32%), Linn (14%), Woodbury (11%), Black Hawk (9%), and Johnson (5%) (Figure 28).

Table 8: Characteristics of Persons Testing HCV Positive at CTR Sites

	Overall		30 and Under	
	No.	**%**	**No.**	**%**
Gender				
Male	171	60.0	58	59.8
Female	114	40.0	39	40.2
Race/Ethnicity				
White, non-Hispanic	238	83.5	79	81.4
Black, non-Hispanic	21	7.4	3	3.1
Latino/Hispanic	12	4.2	7	7.2
American Indian or Alaska Native	7	2.5	4	4.1
Asian, Native Hawaiian or Other Pacific Islander	3	1.1	1	1
Multiple Races	4	1.4	3	3.1
Age At Time Of Test				
Median	36		25	

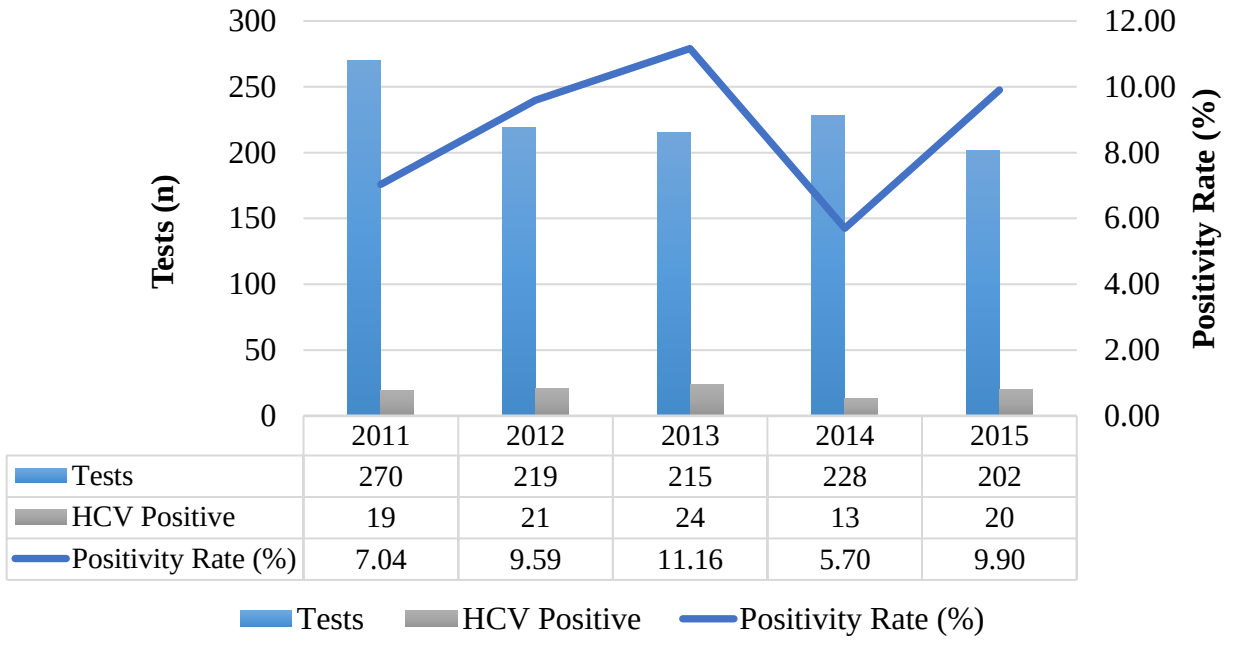
Source: EvaluationWeb, Iowa

Figure 27a: CTR Hepatitis C Positivity by Year for Overall



Source: EvaluationWeb, Iowa

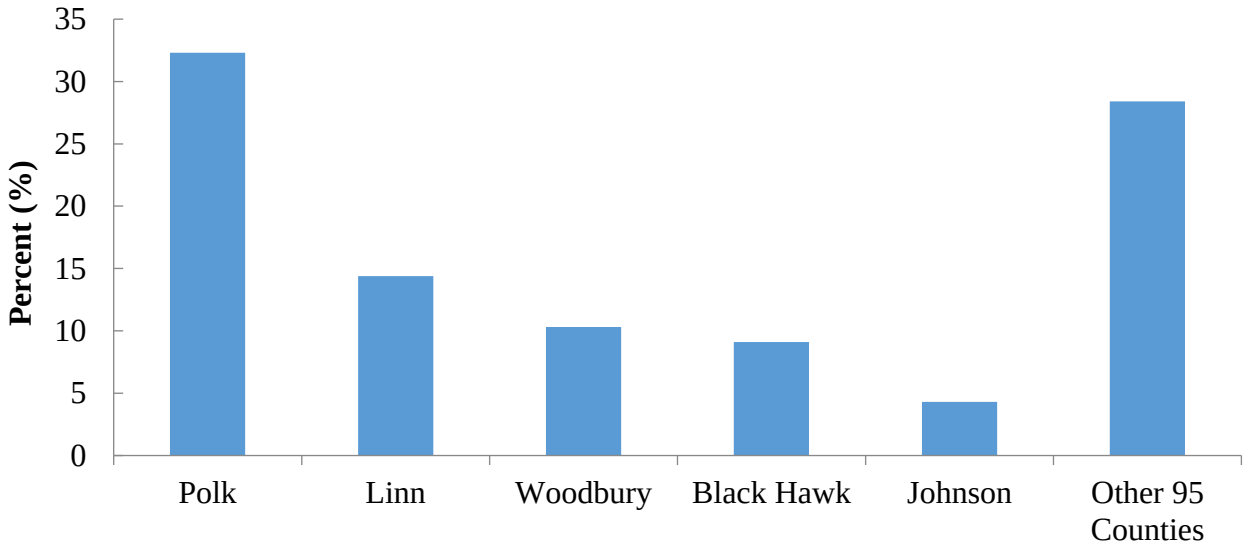
Figure 27b: CTR Hepatitis C Positivity by Year for 30 and Under



	2011	2012	2013	2014	2015
Tests	270	219	215	228	202
HCV Positive	19	21	24	13	20
Positivity Rate (%)	7.04	9.59	11.16	5.70	9.90

Source: EvaluationWeb, Iowa

Figure 28: CTR Data by County for HCV Cases Identified



Source: EvaluationWeb, Iowa

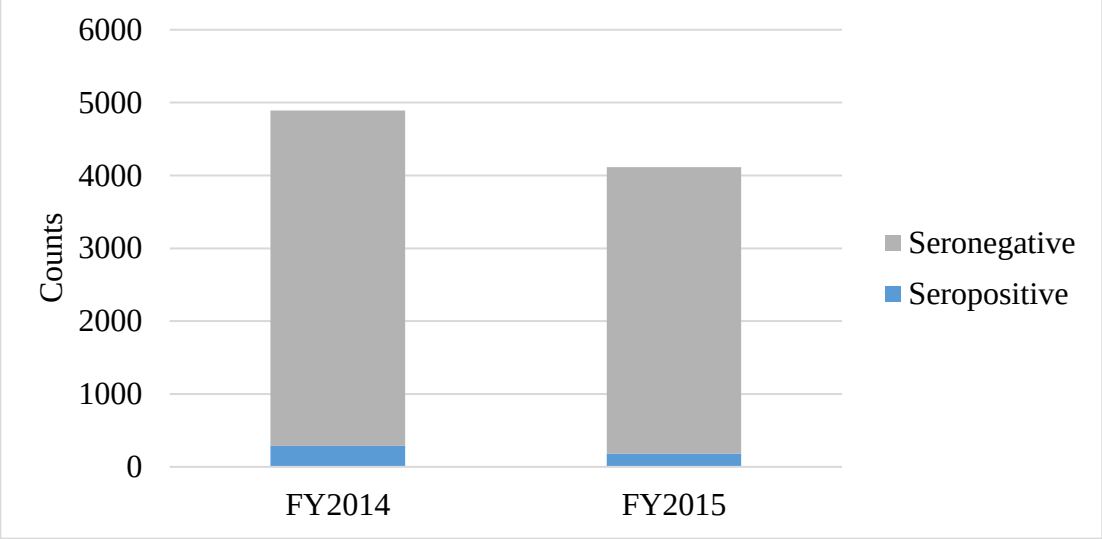
Note: Only counties with the top 5 highest percentages of HCV cases were included on this chart.

Department of Corrections

The prevalence of HCV is much greater among people who are incarcerated than among the general population. There are approximately 2.2 million people in U.S. jails and prisons and, in 2013, the CDC estimated that 1 in 3 have HCV (CDC, 2013). Accordingly, the CDC recommends universal hepatitis C screening for all incarcerated persons (CDC, 2013).

The Iowa Department of Corrections (IDOC) maintains nine prisons across the state. IDOC health services policy and procedures indicate that a hepatitis C antibody screen is completed unless documented data indicate that any or all tests are clinically unnecessary, or a current test has been completed within the IDOC within the last 6 months (IDOC, 2013). Of those entering into the system and warranting screening, over 91% were screened for HCV in fiscal year 2014, with 5.6% testing positive (Figure 29). In 2015, over 78% were screened, and 4.5% tested positive.

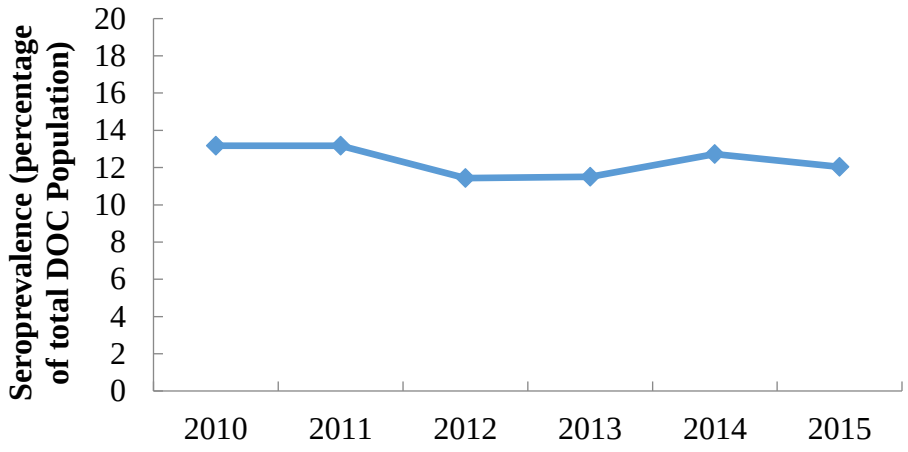
Figure 29: HCV Screening Results of Incoming Incarcerated Individuals in Iowa



Source: Iowa Department of Corrections

From 2006 to 2015, the proportion of the incarcerated who were living with HCV declined slightly from 12.6% to 10.6% (Figure 30). However, it is important to note that these data only account for the individuals incarcerated at any given point in time, and do not account for the movement in and out of IDOC facilities.

Figure 30: The Proportion of Incarcerated in Iowa Prisons who were Positive for HCV from Fiscal Years 2010-2015



Source: Iowa Department of Corrections
Note: State Fiscal Year (FY) runs July 1 through June 30

Heroin and Opioids

Prescription opioid misuse, defined as the nonmedical use of a prescription opioid, has reached a significant level in the United States, particularly among young persons. In 2014, 2.8% of young adults (18 to 25) nationwide reported nonmedical use of prescription pain relievers within the past month compared to 1.8% of adults 26 or older (SAMHSA, 2015). There has been a parallel increase in injection drug use among young adults. The National Survey on Drug Use and Health (NSDUH) found that 0.8% of young adults (18 to 25) reported heroin use (method of use not specified) within the past year (SAMHSA, 2015).

Heroin, an opioid, is one of the most commonly used addictive drugs with a high risk of overdose and death for users. This increase in the use of opioids has been accompanied by similarly high rates of drug treatment admissions for heroin and prescription opioid use among persons aged 12 years or more. Research indicates that the development of tolerance to prescription opioids, cheaper cost of heroin, higher potency of heroin in some locations, ease of injecting heroin, and stigma against injecting prescription opioids are all reasons behind the transition from nonmedical use of prescription opioids to heroin injection (Lankenau et al., 2012a; Lankenau et al., 2012b). According to the NSDUH, people who are addicted to prescription opioids are 40 times more likely to become addicted to heroin.

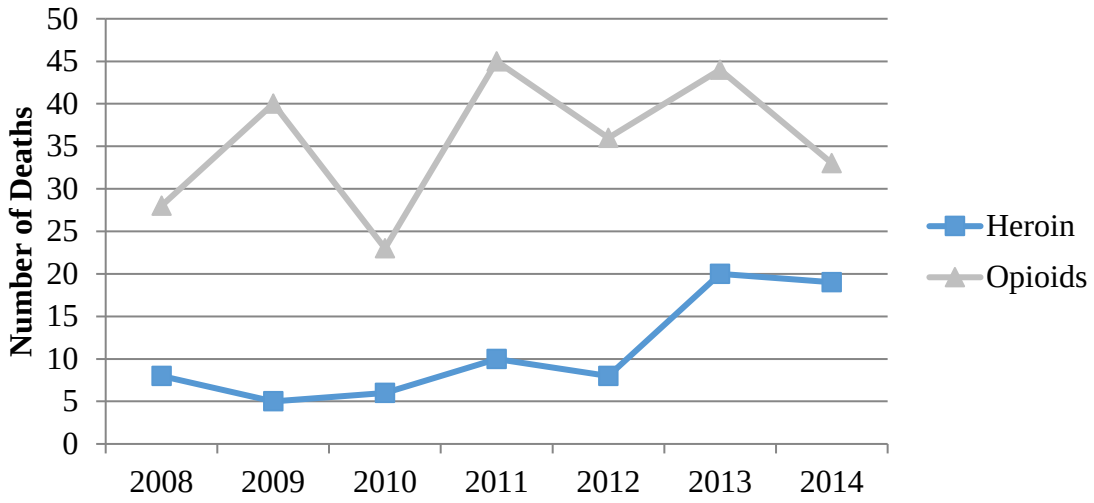
Injection of heroin and other opioids is a public health crisis that is associated with increasing numbers of accidental overdose deaths, exposure to and transmission of HIV, viral hepatitis, and other infectious diseases, and a range of other health and social problems. Research has demonstrated that the hepatitis C virus remains viable outside an infected person (e.g., on drug injection equipment) much longer than HIV. HCV can survive outside the body, under certain conditions, for days in dried blood on inanimate surfaces, cookers, and filters (e.g., cotton or a cigarette filter used to strain particulates from a drug solution); and for even longer under favorable conditions, including the barrel of a syringe (Doerrbecker et al., 2011; Doerrbecker et al., 2012; Painstil et al., 2010). This persistent infectiousness and viability of the virus leads to higher prevalence among people who report injection drug use than for HIV. It is estimated that the prevalence of HCV antibodies is 72% among people who inject drugs in the United States (Nelson et al., 2011)

Heroin and Opioids in Iowa

Similar to the national trend, Iowa has experienced an increase in heroin- and opioid-related hospitalizations, emergency department visits, and overdoses. From 2008 to 2014, the number

of heroin overdose deaths increased from 8 to 19, and the number of deaths from other opioids increased from 28 to 44 in 2013, then decreased slightly to 36 in 2014 (Figure 31).

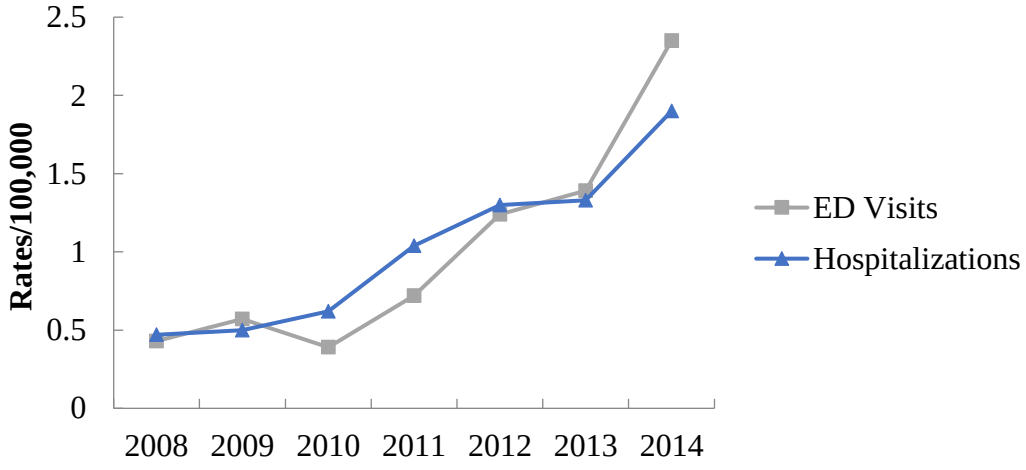
Figure 31: Number of Heroin and Opioid Deaths in Iowa, 2008-2014



Source: Iowa Department of Public Health

Rates of heroin-related emergency department visits and hospitalizations in Iowa increased significantly between 2008 and 2014 (Figure 32). The number of emergency department visits for heroin overdoses increased from about 10 in 2008 to over 70 in 2014.

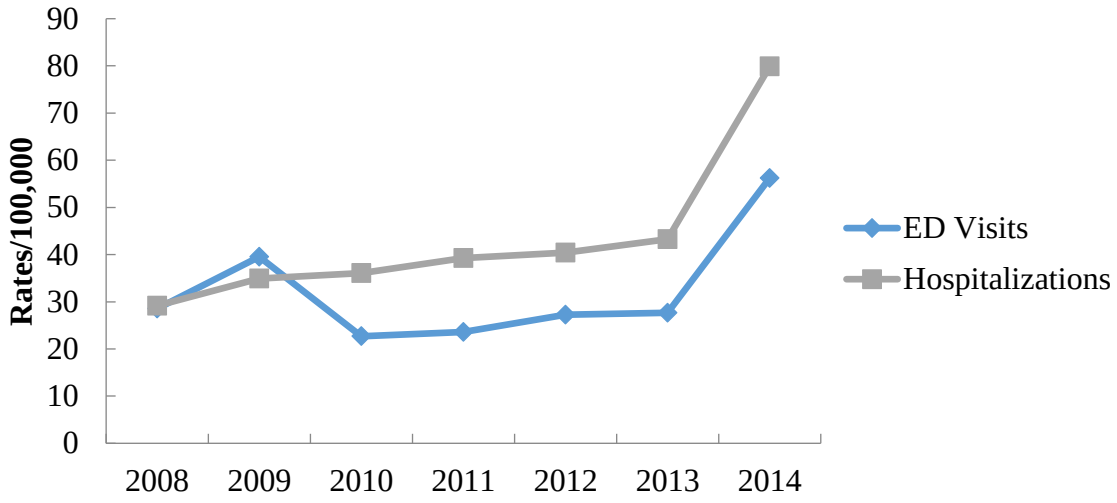
Figure 32: Rates of Heroin-related Emergency Department (ED) Visits and Hospitalizations in Iowa, 2008-2014



Source: Iowa Department of Public Health

Rates of opioid-related emergency department visits and hospitalizations also increased substantially in Iowa from 2008 through 2014 (Figure 33). The number of emergency department visits for opioid-related overdoses increased from over 800 in 2008 to 1,747 in 2014. Similarly, opioid-related hospitalizations tripled from 873 in 2008 to 2,482 in 2014.

Figure 33: Rates of Opioid-Related Emergency Department (ED) Visits and Hospitalizations in Iowa, 2008-2014



Source: Iowa Department of Public Health

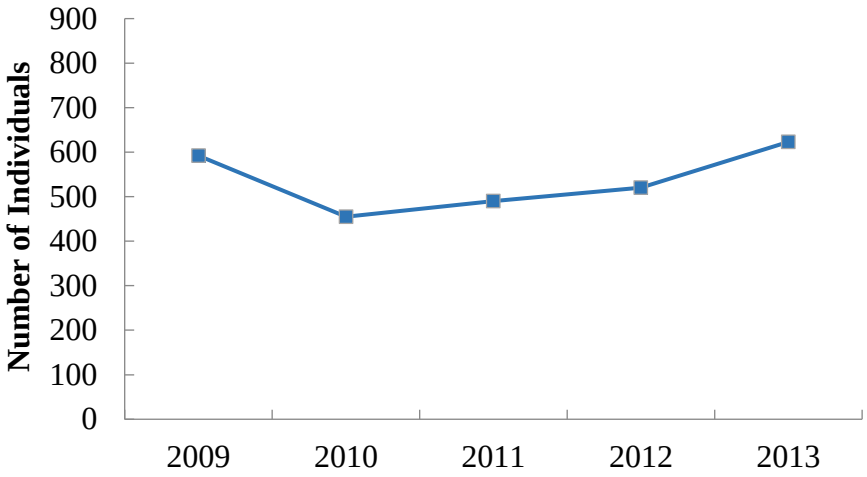
Heroin and Opioid Treatment in Iowa

There are several available options for treating opioid dependence. These options include a combination of behavioral counseling and medications such as Naltrexone, Methadone, and Buprenorphine.

- Naltrexone is an antagonist medication that prevents opioids from activating brain receptors.
- Methadone is an agonist medication that eliminates withdrawal symptoms and relieves cravings by mimicking other opioids.
- Buprenorphine is a partial agonist medication that can reduce cravings, and is typically well-tolerated.

The number of individuals in Opioid-Treatment Programs (OTPs) in Iowa who received methadone has steadily increased since 2010. In 2013, there were 625 individuals (measured as single-day counts) who received methadone through an OTP (Figure 34).

Figure 34: Individuals Enrolled in Opioid Treatment Programs (OTPs) in Iowa Receiving Methadone: Single-Day Counts*

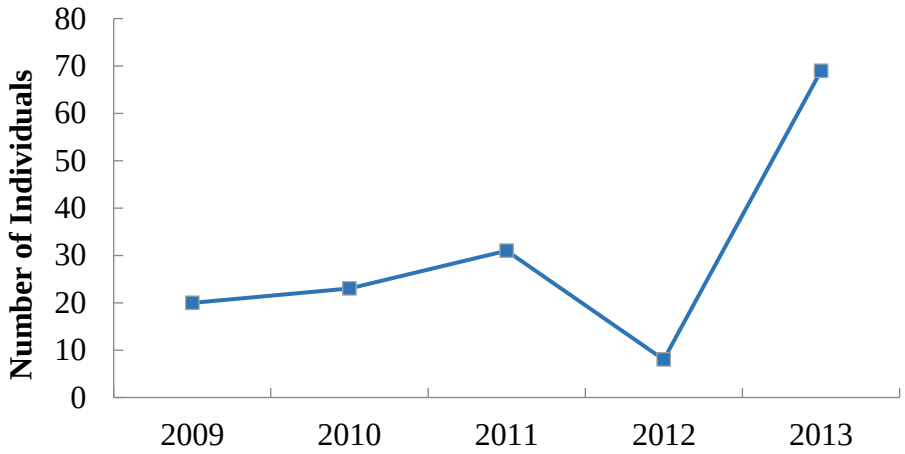


**Single-day counts reflect the number of persons who were enrolled in substance use treatment on March 31, 2009; March 31, 2010; March 31, 2011; March 30, 2012; and March 29, 2013.*

The number of individuals enrolled in substance abuse treatment in Iowa who received buprenorphine, measured as single-day counts, did not vary significantly between 2009 and 2012, then increased sharply between 2012 and 2013 (Figure 35). Buprenorphine, which is an opioid use disorder treatment, is strictly regulated. Qualified physicians are required to acquire and maintain certifications to legally dispense or prescribe opioid dependency medications. According to the buprenorphine treatment physician locator on the SAMHSA website, 36 physicians in Iowa are authorized to treat opioid dependence using buprenorphine. (Please visit: http://www.samhsa.gov/medication-assisted-treatment/physician-program-data/treatment-physician-locator).

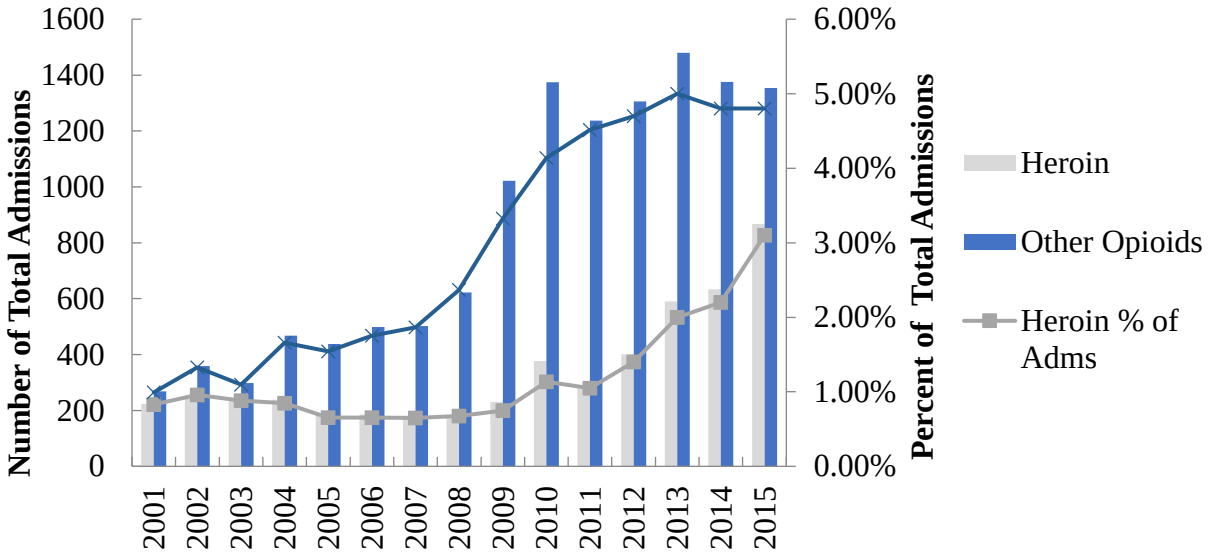
As of March 2016, there were 118 licensed substance abuse treatment agencies in Iowa. The number of total admissions to treatment agencies for heroin has increased steadily since 2001, quadrupling from 2001 to 2015. The number of total admissions to treatment agencies for other opioids (excluding heroin) has experienced a five-fold increase, from 268 in 2001 to over 1,300 in 2015. The percentages of total admissions for heroin and other opioids have also increased. The percent of total admissions for other opioids was less than 1% in 2001, and 4.80% in 2015 (Figure 36).

Figure 35: Individuals Enrolled in Substance Abuse Treatment in Iowa Receiving Buprenorphine: Single-Day Counts*



**Single-day counts reflect the number of persons who were enrolled in substance use treatment on March 31, 2009; March 31, 2010; March 31, 2011; March 30, 2012; and March 29, 2013.*

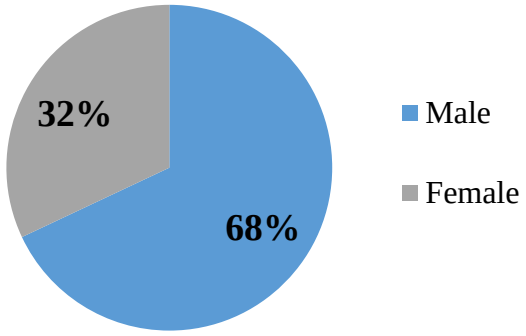
Figure 36: Heroin and Other Opioids Admissions to Substance Use Treatment Facilities in Iowa, 2001 – 2015



Source: SAMHSA, Treatment Episode Data Set (TEDS)

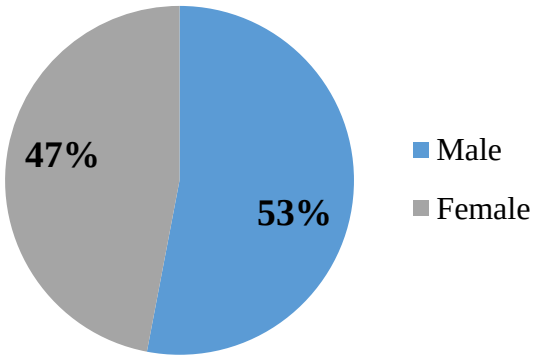
More than two-thirds (68%) of heroin admissions to substance abuse treatment agencies in Iowa in 2014 were among men (Figure 37). Comparatively, slightly more than half (53%) of admissions for other opioids were also among men (Figure 38).

Figure 37: Heroin Admissions to Substance Abuse Treatment Agencies in Iowa by Sex, 2014



Source: SAMHSA, Treatment Episode Data Set (TEDS)

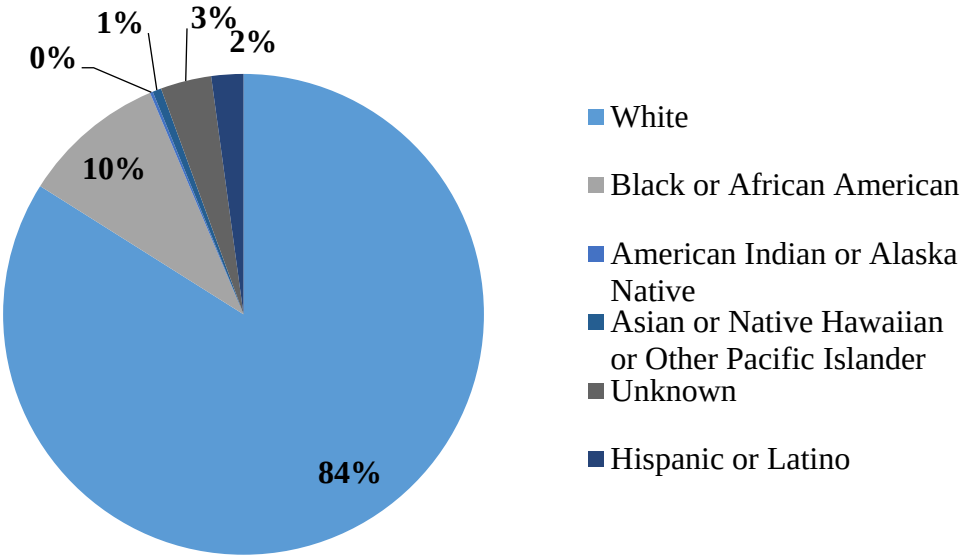
Figure 38: Other Opioids Admissions to Substance Abuse Treatment Agencies in Iowa by Sex, 2014



Source: SAMHSA, Treatment Episode Data Set (TEDS)

Treatment admissions for heroin and opioids in Iowa varied by race and ethnicity in 2014. While black, non-Hispanic people make up 3.1% of the population of Iowa, they accounted for almost 10% of treatment admissions for heroin in 2014 (Figure 39). Comparatively, 95% of treatment admissions for other opioids were among whites in 2014.

Figure 39: Percent of Heroin Admissions to Substance Abuse Treatment Agencies by Race/Ethnicity, 2014



Source: SAMHSA, Treatment Episode Data Set (TEDS)

Prescriber Data

The distribution of providers in Iowa who prescribed at least one direct-acting antiviral drug for HCV treatment between 2011 and 2015 was used as an indicator of treatment in Iowa. Out of the 99 Iowa counties, there were 29 in which a medical provider prescribed a treatment for HCV. In 2015 alone, there were only 17 counties where a provider prescriber a HCV treatment. Table 9 indicates the total number of prescribers per county in 2015.

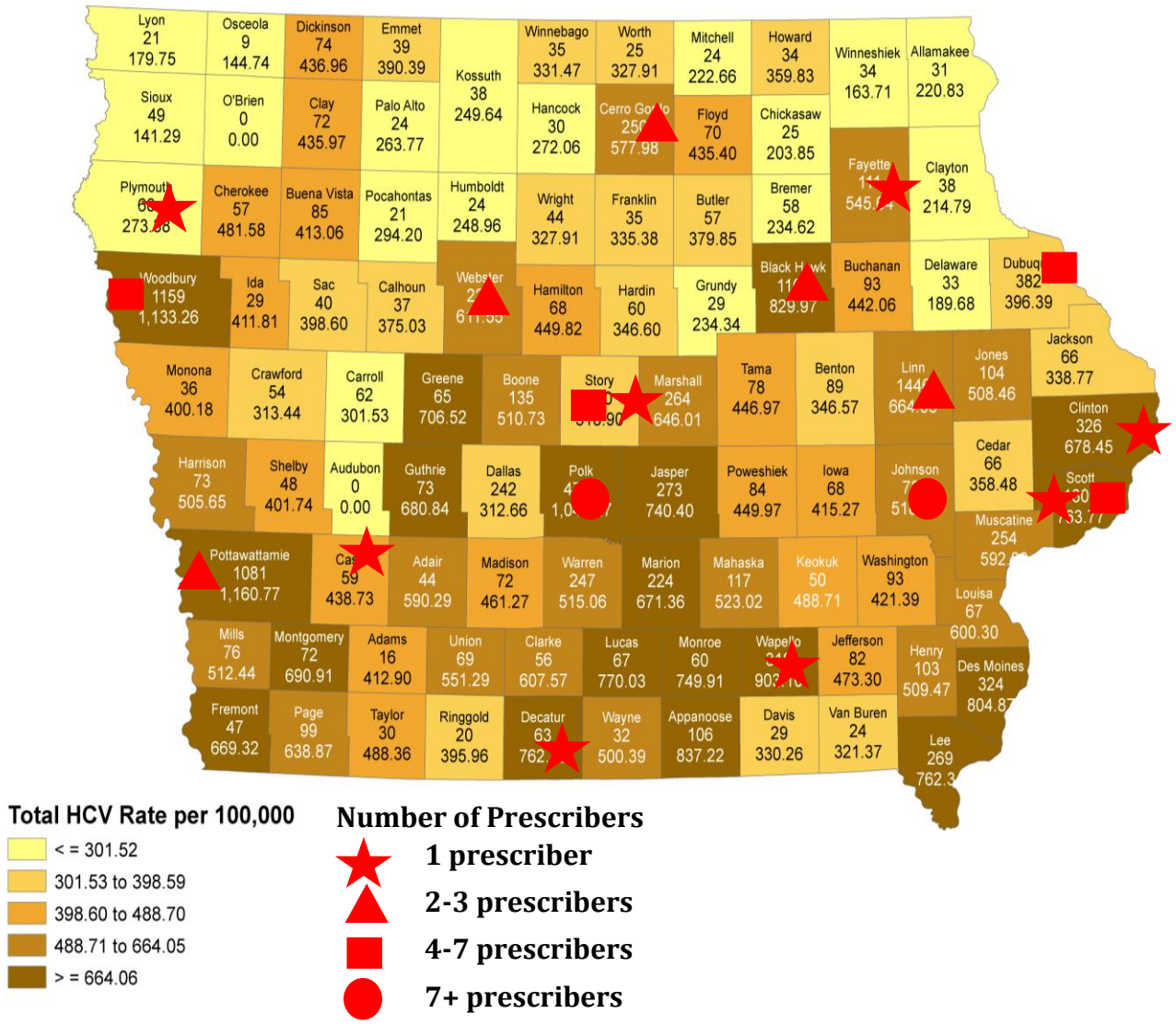
Table 9: Number of HCV Treatment Prescribers by County in 2015

County	Number of Medical Providers Who Wrote at Least One Prescription for HCV Treatment in 2015
Cass	1
Black Hawk	3
Cerro Gordo	3
Clinton	1
Decatur	1
Dubuque	6
Fayette	1
Johnson	12
Linn	3
Marshall	1
Polk	27
Pottawattamie	2
Scott	5
Story	7
Wapello	1
Webster	3
Woodbury	7
Total	84

Source: IMS Government Solutions

The distribution of HCV treatment providers was mapped against the prevalence of HCV cases in Iowa (Figure 40). Note that in 2015, there were no prescribers in extreme southeastern Iowa, even though the HCV rates in Des Moines and Lee counties were in the highest quartile. HCV rates were also high in many counties in south central Iowa, but only two providers in that area prescribed HCV treatment in 2015.

Figure 40: Distribution of HCV Treatment Prescribers (2015) and Prevalence of HCV



Data Sources and Methods

Hepatitis C Data

HCV data are collected in the Iowa Disease Surveillance System, which is a web-based system designed to facilitate reporting, investigation, and surveillance of communicable diseases in Iowa. HCV is a reportable disease as defined by Iowa Code 139A. Reports of HCV infection are submitted by local public health, private providers, laboratories, and other disease reporters. IDSS is not a static database, as cases can be updated daily. Additionally, some records had incomplete data, which was a limitation of analysis.

Hepatitis C test results in IDSS were defined as screening or confirmatory by the following criteria:

Screening tests: *(usually reported as positive or negative)*

- HCV Ab Signal/Cutoff by EIA antibody (See Interpretation & Numeric Result)
- Serology – HCV antibody (EIA) (positive, negative, equivocal, or not reactive)
- Serology – Anti-HCV antibody test (positive, negative, equivocal, or not reactive)
- Serology – HCV IgG antibody (EIA) (positive, negative, equivocal, not reactive, or See Interpretation & Numeric Result)
- Serology – HCV IgM antibody (EIA) (positive, negative, equivocal, not reactive, or See Interpretation & Numeric Result)

Confirmatory tests:

- PCR (detected, equivocal, indeterminate, not detected, not quantified, or not tested)
- Genotype (detected, not detected, or indeterminate)
- Serology – RNA QL (positive, negative, equivocal, or not reactive)
- Serology – HCV RIBA (antibody test – does not indicate current infection) (negative, positive, or not done)
- Serology – HCV RNA (positive, negative, or not done)
- Serology – HCV DNA QL Log (positive, negative, equivocal, or indeterminate)

Liver Cancer

Since 1973, the State Health Registry of Iowa (SHRI) has recorded cancer incidence and mortality. Mortality data are from the Iowa Department of Public Health (IDPH). Both the registry and IDPH data were from 2000-2012 and obtained using SEER*Stat and the Iowa Cancer Registry (http://www.cancer-rates.info/ia/). Due to time constraints, no linkage was performed between IDSS and the Iowa Cancer Registry, so liver cancer incidence and mortality may not be exclusively related to viral hepatitis C. SHRI is a population-based cancer registry, and member of the National Cancer Institute's Surveillance, Epidemiology, and End Results

(SEER) Program. Since 1982, cancer has been a reportable disease in Iowa and SHRI has been delegated the responsibility for data collection. Cancer patient data are collected from hospitals, pathology laboratories, cancer treatment centers, and Iowa death certificates. SHRI also collects data from targeted physicians that send their pathology specimens to out-of-state laboratories. Queries using SEER*Stat Software Version 8.3.2 were utilized to generate cancer mortality and incidence rates by age, gender, and county for the state of Iowa.

U.S. rates for comparison are from the SEER Cancer Statistics website at:
http://seer.cancer.gov/statfacts/html/livibd.html

Liver Transplant

HCV-Specific Liver Transplants are HCV-related liver transplants derived from the U.S. Department of Health and Human Services Organ Procurement and Transplantation Network (OPTN) online UNetSM database developed by the United Network for Organ Sharing (UNOS). HCV-specific liver transplants included diagnoses of acute hepatic necrosis: type c, cirrhosis type c, cirrhosis type B and C, cirrhosis: chronic active hepatitis: etiology unknown, and alcoholic cirrhosis with hepatitis. Hepatocellular carcinoma and cirrhosis transplants included: Hepatoma (HCC) and Cirrhosis, hepatoma-Hepatocellular Carcinoma. This work was supported in part by Health Resources and Services Administration contract 234-2005-37011C. The content is the responsibility of the authors alone and does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

Inpatient and Emergency Department Visits

The Iowa Public Health Tracking Portal is a public web-based portal which provides state and county level public health data. The tracking portal provides significant opportunity to share data with the public, public health partners, local public health, and IDPH staff and enhance evidence-based public health decision-making in Iowa. An open portal provides analyzed data to the public on a variety of public health topics including environment, health effects and population. A secure portal allows local public health and other public health practitioners access to less suppressed data and additional analytic tools.

From the Iowa Public Health Tracking Portal, the following data were accessed:
<u>HCV-related hospitalizations and emergency department visits</u>
The following ICD-9 codes were used to define hospitalizations in Iowa related to hepatitis C virus: 70.41, 70.44, 70.51, 70.54, 70.7, and 70.71

A discharge event occurs when an outpatient or inpatient is discharged from an Iowa hospital. All discharge data comes from the Statewide Outpatient Database. This subject area includes discharge events each of which represents a unique discharge of an outpatient or inpatient from an Iowa hospital.

Heroin and Opioid-related hospitalizations and emergency department visits

The following ICD-9 codes were used to define hospitalizations in Iowa related to overdose of heroin or other opioids: 965.00, 965.01, 965.02, 965.09, E850.0, E850.1, and E850.2

Substance Use Treatment Admissions

Treatment admissions data were accessed through the Treatment Episode Data Set (TEDS), which is maintained by the Center for Behavioral Health Statistics and Substance Abuse and Mental Health Services (SAMHSA). TEDS includes records for nearly 1.5 million substance abuse treatment admissions annually. This profile included self-reported data for those ages 12 and older. It should be noted that TEDS is admissions data; therefore, each report is not reflective of an individual, but could be the same person admitting more than once. Treatment data for Iowa are derived from the 93 sites that report treatment data through the Iowa Service Management and Reporting Tool (I-SMART).

Substance Use by Iowans

The National Survey on Drug Use and Health (NSDUH) provides national and state-level data on the use of tobacco, alcohol, illicit drugs (including non-medical use of prescription drugs) and mental health in the United States. NSDUH is sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA), an agency in the U.S. Department of Health and Human Services (DHHS). NSDUH is an annual nationwide survey involving interviews with approximately 70,000 randomly selected individuals aged 12 or older.

Counseling, Testing, and Referral

Data on hepatitis C testing occurring at IDPH-funded Counseling, Testing, and Referral (CTR) sites are collected and reported in EvaluationWeb, a web-based data collection and reporting system designed by Luther Consulting, LLC.

HIV and HCV Co-Infections

Co-infection data was determined by a match between the HCV Surveillance database (IDSS) and the Iowa electronic HIV/AIDS Reporting System (eHARS), and were supplemented by data from three Ryan White-funded clinics. All HIV-infected persons who were first diagnosed while living in Iowa, or who have lived in Iowa at some point in time while infected with HIV, or who

have accessed care at an Iowa facility and have been reported to IDPH, are included in eHARS. All reports of HCV infection as of 12/31/2015 were matched to HIV reports in eHARS as of 12/31/2015. Matches were based on date of birth, last name, and Soundex of first name. Persons with at least one infection reported in both databases were considered to be HIV/HCV co-infected.

Prescriber data

Data on healthcare providers who prescribed hepatitis C antiviral medications were purchased from IMS Government Solutions. Data represent providers in Iowa who wrote one or more prescriptions for a direct-acting antiviral for HCV to a retail store or for mail-order between 2011 and 2015. Antiviral medications included: Copegus, Daklinza, Harvoni, Incivek, Moderiba, Olysio, Rebetol, Ribasphere, Ribasphere Ribapak, Ribatab, Ribavirin, Sovaldi, Technivie, Victrelis, Viekira Pak, and Zepatier. Medications data are provided for the prescriber's primary address only, and may not reflect true location of HCV treatment.

Resources

Iowa-Specific Resources for HIV and HCV

Directory of Iowa Physicians Treating Viral Hepatitis

http://idph.iowa.gov/Portals/1/userfiles/40/Directory%20of%20Physicians%20Treating%20Viral%20Hepatitis%20Patients%20January%202016.pdf

Hepatitis C Program

http://idph.iowa.gov/hivstdhep/hep

HIV Program

http://idph.iowa.gov/hivstdhep/hiv

HIV Services Directory

http://idph.iowa.gov/Portals/1/Files/HIVSTDHEP/Services%20Directory%20March%202014.pdf

HIV Statistics and Reports

http://idph.iowa.gov/hivstdhep/hiv/data

IDPH Counseling, Testing, and Referral Sites

http://idph.iowa.gov/Portals/1/userfiles/40/CTR%20Sites%202015%20for%20web-%209-16-15.pdf

Viral Hepatitis Strategic Plan

http://idph.iowa.gov/Portals/1/Files/HIVSTDHEP/Iowa%20Viral%20Hepatitis%20Strategic%20Plan.pdf

Provider Resources

A list of training courses, fact sheets, and other materials for health care providers is listed below. However, it is not a comprehensive list of all available materials on hepatitis C.

American Association for the Study of Liver Diseases

http://hcvguidelines.org/

American Journal of Medicine's Hepatitis C: Screening, Diagnosis, Treatment and Management

http://hepcresource.amjmed.com/

Centers for Disease Control and Prevention Recommended Testing Sequence for Identifying Current Hepatitis C Virus (HCV) Infection

http://www.cdc.gov/hepatitis/hcv/pdfs/hcv_flow.pdf

Guidelines for Laboratory Testing and Result Reporting of Antibody to Hepatitis C Virus

http://www.cdc.gov/mmwr/PDF/rr/rr5203.pdf

Hepatitis C Fact Sheet
http://idph.iowa.gov/Portals/1/Files/HIVSTDHEP/hepcfact.pdf

Hepatitis C Virus Infection in Young Persons Who Inject Drugs
https://www.aids.gov/pdf/hcv-and-young-pwid-consultation-report.pdf

Hepatitis C Online Course
http://www.hepatitisc.uw.edu/alternate

Interpretation of Hepatitis C Test Results
http://www.cdc.gov/hepatitis/HCV/PDFs/hcv_graph.pdf

National Alliance of State and Territorial AIDS Directors (NASTAD)
https://www.nastad.org/

National Hepatitis C Prevention Strategy: A Comprehensive Strategy for the Prevention and Control of Hepatitis C Virus Infection and its Consequences
http://stacks.cdc.gov/view/cdc/6458

National HIV/AIDS Strategy
https://www.aids.gov/federal-resources/national-hiv-aids-strategy/nhas-update.pdf

National Action Plan for the Prevention, Care, & Treatment of Viral Hepatitis
https://www.aids.gov/pdf/viral-hepatitis-action-plan.pdf

National Hepatitis Training Institute
http://www.knowhepatitis.org/

National Viral Hepatitis Roundtable (NVHR)
http://nvhr.org/

Nine Tips for Treating Hepatitis C in Current and Former Substance Users
http://harmreduction.org/wp-content/uploads/2011/12/9TipsforTreatingHCV.pdf

Recommendations for the Identification of Chronic Hepatitis C Virus Infection Among Persons Born During 1945-1965
http://www.cdc.gov/mmwr/pdf/rr/rr6104.pdf

Recommendations for Testing, Managing, and Treating Hepatitis C
http://hcvguidelines.org

Recommendations for Prevention and Control of Hepatitis C Virus (HCV) Infection and HCV-related Chronic Disease
http://www.cdc.gov/mmwr/PDF/RR/RR4719.pdf

United States Public Health Services Task Force Hepatitis C Screening Recommendations
http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/hepatitis-c-screening

Viral Hepatitis Serology Online Training (CDC)
http://www.cdc.gov/hepatitis/Resources/Professionals/Training/Serology/training.htm

Patient Resources

A list of training courses, fact sheets, and other materials for people is listed below. However, it is not a comprehensive list of all available materials on hepatitis C.

American Liver Foundation, Hepatitis C
http://hepc.liverfoundation.org/

CDC Patient Education Resources
http://www.cdc.gov/hepatitis/hcv/patienteduhcv.htm

HCV Advocate
http://www.hcvadvocate.org/

Faces of Hepatitis
http://www.viralhepatitisaction.org/faces

First Steps with Hepatitis C for those Newly Diagnosed
http://hcvadvocate.org/hepatitis/First%20Steps/First_Steps_with_Hepatitis_C_for_the_Newly_Diagnosed.pdf

Hepatitis C Baby Boomer Resources
http://nvhr.org/program

Hepatitis C for Veterans and the Public
http://www.hepatitis.va.gov/patient/hcv/index.asp

Substance Abuse & Mental Health Behavior Health Treatment Facility Locator
http://findtreatment.samhsa.gov

Viral Hepatitis Risk Assessment
http://www.cdc.gov/hepatitis/RiskAssessment/index.htm

References

American Cancer Society (ACS). Last Revised: March 28, 2016. *Key statistics about liver cancer.* Online. Accessed: May 1, 2016. http://www.cancer.org/cancer/livercancer/detailedguide/liver-cancer-what-is-key-statistics.

American Liver Foundation (ALF). (2015). *Advances in medications to treat hepatitis C.* Retrieved from http://hepc.liverfoundation.org/treatment/the-basics-about-hepatitis-c-treatment/advances-in-medications/

Bentley, T. S. (2014). *U.S. organ and tissue transplant cost estimates and discussion.* Milliman Research Report. http://www.milliman.com/uploadedFiles/insight/Research/health-rr/1938HDP_20141230.pdf.

Center for Behavioral Health Statistics and Quality. (2015). *Behavioral health trends in the United States: Results from the 2014 National Survey on Drug Use and Health (HHS Publication No. SMA 15-4927, NSDUH Series H-50).* Retrieved from http://www.samhsa.gov/ data/

Centers for Disease Control and Prevention (2015). *Statistics and surveillance*. Retrieved from http://www.cdc.gov/hepatitis/statistics/.

Centers for Disease Control and Prevention. (2015*). HIV/AIDs and viral hepatitis.* Retrieved from http://www.cdc.gov/hepatitis/populations/hiv.htm.

Centers for Disease Control and Prevention. (12 August 2013). *Prescription Drug Overdose Data & Statistics: Guide to ICD-9-CM and ICD-10 Codes Related to Poisoning and Pain.* Accessed 12 February 2016. Online. Available at: http://www.cdc.gov/drugoverdose/pdf/pdo_guide_to_icd-9-cm_and_icd-10_codes-a.pdf

Centers for Disease Control and Prevention. (2013). *Hepatitis C & Incarceration.* from http://www.cdc.gov/hepatitis/HCV/PDFs/HepCIncarcerationFactSheet.pdf

Centers for Disease Control and Prevention. (2015) *Community outbreak of HIV infection linked to injection drug use of oxymorphone – Indiana, 2015*. *MMWR* 2015:64(16); 443-44. *http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6416a4.htm?s_cid=mmmm6416a4_w*

Centers for Disease Control and Prevention. (2016). *Hepatitis C FAQs for the Public.* Online. Accessed March 4, 2016. http://www.cdc.gov/hepatitis/hcv/cfaq.htm#cFAQ11

Centers for Disease Control and Prevention. Hepatitis C. (2016). *Infectious Disease Related to Travel.* Accessed March 4, 2016. http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/hepatitis-c

Centers for Disease Control and Prevention. (March 11, 2016). *Viral Hepatitis—Hepatitis C Information.* Retrieved from http://www.cdc.gov/hepatitis/hcv/hcvfaq.htm.

Centers for Disease Control and Prevention. (2012). *Morbidity and Mortality Weekly Report*: 61 (4). Retrieved from http://www.cdc.gov/mmwr/pdf/rr/rr6104.pdf.

Dionne-Odom, J., Osborn, M.K., Radziewicz, H., et al. (2009). Acute hepatitis C and HIV coinfection. *Lancet Infect Dis*, 9:775–83.

Doerrbecker, J., Behrendt, P., Mateu-Gelabert, P., Ciesek, S., Riebesehl, N., Wilhelm, C., et al. (2012). Transmission of hepatitis C virus among people who inject drugs: Viral stability and association with drug preparation equipment, *J Infect Dis*, *207*(2), 281-287.

Doerrbecker, J., Friesland, M., Ciesek, S., Erichsen, T.J., Mateu-Gelabert, P., Steinmann, J., et al. (2011). *I*nactivation and survival of hepatitis C virus on inanimate surfaces. *J Infect Dis*, *204*(12), 1830-1838.

Edlin, B.R., Eckhardt, B.J., Shu, M.A., Holmberg, S.D., & Swan, T. *(*2015). Toward a More Accurate Estimate of the Prevalence of Hepatitis C in the United States. *Hepatology, 62* (5): 1353-1363.

Fierer, D.S., Mullen, M.P., Dieterich, D.T., et al. (2012). Early-onset liver fibrosis due to primary hepatitis C virus infection is higher over time in HIVinfected men. *Clin Infect Dis*,55:887–9.

Fierer, D.S., Uriel, A.J., Carriero, D.C., et al. (2008). Liver fibrosis during an outbreak of acute hepatitis C virus infection in HIV-infected men: a prospective cohort study. *J Infect Dis*, 198:683–6.

Galbraith, J., Donnelly, J.P., Franco, R.A., Overton, E.T., Rodgers, J.B., & Wang, H.E. (2014). National estimates of health care utilization by individuals with Hepatitis C Virus infection in the United States. Clinical Infectious Diseases, 59 (6): 755-64.

Garg, S., Taylor, L.E., Grasso, C., et al. (2013). Prevalent and incident hepatitis C virus infection among HIV-infected men who have sex with men engaged in primary care in a Boston community health center. Clin Infect Dis, 56:1480–7.

Gasiorowicz, M., Hurie, M., Russell, A., Hoxie, N., & Vergeront, J. (2006). Epidemiologic trends in infection, mortality, and transplants related to hepatitis C in Wisconsin. *Wisconsin Medical Journal*, *105*(1): 34-39.

Hagan, H., Pouget, E.R., Des Jarlais, D.C., & Lelutiu-Weinberger, C. (2008). Meta-regression of hepatitis C virus infection in relation to time since onset of illicit drug injection: the influence of time and place. *Am J Epidemiology,168*(10):1099-109. doi: 10.1093/aje/kwn237. Epub 2008 Oct 9.

Iowa Department of Corrections (IDOC). Policy and Procedures. (2014). *In Chapter 6: Health Services. Sub-chapter: Health Screening and Appraisals*. Online. Effective Date: October 2014. http://www.doc.state.ia.us/Policies/DownloadPolicy/1057.

Iowa Department of Public Health, Bureau of Health Statistics. (2015). Retrieved from *http://idph.iowa.gov/health-statistics*

Indiana State Department of Health. (2015). *Long-Term Planning Process Update Southeastern Indiana HIV Outbreak, June 17, 2015*. Retrieved from http://www.in.gov/isdh/files/Briefing

Iowa Cancer Registry, State Health Registry of Iowa. (2015. *Iowa Cancer Data*. Retrieved from http://www.cancer-rates.info/ia/index.php.

Iowa Department of Public Health. (2016). Iowa Public Health Tracking Portal. Retrieved on April 21, 2016 from https://pht.idph.state.ia.us.

Lankenau, S., Teti, M., Silva, K., Jackson Bloom, J., Harocopos, A., & Tresse, M. (2012a). Patterns of prescription drug misuse among young injection drug users. *Journal of Urban Health, 89*: 1004-16.

Lankenau, S., Teti, M., Silva, K., Jackson Bloom, J., Harocopos, A., & Tresse, M. (2012b) Initiation into prescription opioid misuse among young injection drug users. *International Journal of Drug Policy, 23*: 37-44

Ly, K. N., Hughes, E. M., Jiles, R. B., & Holmberg, S. D. (2016). Rising Mortality Associated With Hepatitis C Virus in the United States, 2003–2013. *Clinical Infectious Diseases, 62*(10), 1287-1288. doi:10.1093/cid/ciw111

National Cancer Institute. (November 5, 2014). *A Snapshot of Liver Cancers.* Online. Accessed: May 1, 2016. http://www.cancer.gov/research/progress/snapshots/liver.

National Institute of Diabetes and Digestive and Kidney Disease. (2012) *Liver Transplantation*. http://www.niddk.nih.gov/health-information/health-topics/liver-disease/liver-transplant/Pages/facts.aspx.

Nelson P.K., Mather, B.M., Cowie, B., Hagan, H., Des Jarlais, D., Horyniak, D., Degenhardt, L. (2011). Global epidemiology of hepatitis B and hepatitis C in people who inject drugs: results of systematic reviews. *The Lancet, 378*(9791): 571-583.

Oramasionwu, C., Johnson, T., Moore, H., & Frei, C. (2014). National trends in hospitalization and mortality rates for patients with HIV, HCV, HIV/HCV coinfection from 1996-2010 in the United States: a cross- sectional study. *BMC Infectious Diseases, 14* (536).

Paintsil, E., He., H., Peters, C., Lindenbach, B.D., & Heimer, R. (2010). Survival of hepatitis C virus in syringes: Implication for transmission among injection drug users. *J Infect Dis, 202*(7), 984-990.

Razavi, H., ElKhoury, A. C., Elbasha, E., Estes, C., Pasini, K., Poynard, T., & Kumar, R. (2013). Chronic Hepatitis C Virus (HCV) Disease Burden and Cost in the United States. Hepatology (Baltimore, Md.), 57(6), 2164–2170. http://doi.org/10.1002/hep.26218

Ryerson, A. B., Eheman, C. R., Altekruse, S. F., Ward, J. W., Jemal, A., Sherman, R. L., Henley, S. J., Holtzman, D., Lake, A., Noone, A.-M., Anderson, R. N., Ma, J., Ly, K. N., Cronin, K. A., Penberthy, L. and Kohler, B. A. (2016). Annual Report to the Nation on the Status

of Cancer, 1975-2012, featuring the increasing incidence of liver cancer. *Cancer*. doi: 10.1002/cncr.29936

State of Iowa Department of Corrections, Policy and Procedures. *Chapter 6: Health Services. Sub-chapter: Health Screenings & Appraisals. Subject: IDOC Initial Health Screening and Appraisal*. http://www.doc.state.ia.us/Policies/DownloadPolicy/1057

Substance Abuse and Mental Health Services Administration (SAMHSA), Center for Behavioral Health Statistics and Quality. *Treatment Episode Data Set (TEDS): 2001-2011. State Admissions to Substance Abuse Treatment Services.* BHSIS Series S-XX, Rockville, MD: Substance Abuse and Mental Health Services Administration.

Substance Abuse and Mental Health Services Administration (SAMHSA). (2016). *Behavioral Health Barometer, Iowa 2014*. Accessed March 4, 2016. http://store.samhsa.gov/shin/content//SMA15-4895/BHBarometer-IA.pdf.

Taylor, L.E., DeLong, A.K., Maynard, M.A., et al. (2011). Acute hepatitis C virus in an HIV clinic: a screening strategy, risk factors, and perception of risk. *AIDS Patient Care STDS*, 25:571–7.

The University of Iowa College of Public Health and the State Health Registry of Iowa. 2016. *Cancer in Iowa: 2016.* Online. Accessed: May 1, 2016. https://www.public-health.uiowa.edu/shri/pubs/pdf/Cancer_2016.pdf.

United States Census Bureau (2014). *2010-2014 American Community Survey 5-year estimates.* Retrieved from http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.

United States Department of Commerce. (2014). *Income and poverty in the United States: 2014.* Retrieved from https://www.census.gov/content/dam/Census/library/publications/2015/demo/p60-252.pdf.

United States Preventive Services Task Force (2013). *Hepatitis C: Screening.* Retrieved from http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/hepatitis-c-screening

Urbanus, A.T., van de Laar, T.J., Stolte, I.G., et al. (2009). Hepatitis C virus infections among HIV-infected men who have sex with men: an expanding epidemic. *AIDS*, 23:F1–7.

van de Laar, T., Pybu,s O., Bruisten, S., et al. (2009) Evidence of a large, international network of HCV transmission in HIV-positive men who have sex with men. *Gastroenterology*, 136:1609–17.

Ward, JW. (2013). The Epidemiology of Chronic Hepatitis C and One-time Hepatitis C Virus Testing of Persons Born during 1945-1965 in the United States. *Clinical Liver Disease: 17*(1). http://www.ncbi.nlm.nih.gov/pubmed/23177279

Younossi, Z. M., LaLuna, L. L., Santoro, J. J., Mendes, F., Araya, V., Ravendhran, N., … Stepanova, M. (2016). Implementation of baby boomer hepatitis C screening and linking to care in gastroenterology practices: a multi-center pilot study. BMC Gastroenterology, 16, 45. http://doi.org/10.1186/s12876-016-0438-z

Appendix

Calculating the Estimated Number of Iowans Living with HCV, Diagnosed and Undiagnosed

Calculation of the Number of Diagnosed Iowans with Chronic Infection

There are 13,660 people in Iowa who have been reported with evidence of active infection for HCV. There are another 8,088 people with evidence of antibodies for HCV but for whom the more specific confirmatory RNA test was not completed (indicating chronic infection).

CDC estimates that 75 to 85% of people initially infected with HCV become chronically infected. Therefore, of the 8,088 people with antibodies for HCV, between 6,066 (75% of 8,088) and 6,875 (85% of 8,088) likely have chronic infection.

Adding each of these values (6,066 and 6,875) to the number of people with evidence of active infection (13,660), gives a range of 19,726 (13,660 + 6,060) to 20,535 (13,660 + 6,875) people diagnosed with HCV who have an active, chronic infection.

Calculation of the Range of the Total Number of Iowans living with HCV

CDC estimates that 45 to 85% of people living with HCV are undiagnosed, which means that between 15% and 55% of people living with HCV have been diagnosed. Now that we know a range for the number of Iowans diagnosed with HCV, we can apply the CDC estimates to calculate the number of Iowans who would be living with HCV (diagnosed + undiagnosed).

To calculate the smallest number of Iowans potentially living with HCV, we assume that as few as 19,726 Iowans have been diagnosed with HCV, and we assume that this number represents an estimated 55% of all Iowans with HCV. In that case, 35,865 Iowans could be living with HIV (both diagnosed and undiagnosed), calculated as 19,726 divided by 0.55.

To calculate the largest number of Iowans potentially living with HCV, we assume that as many as 20,535 Iowans have been diagnosed with HCV, and we assume that this number represents only 15% of all Iowans with HCV. In that case, 136,900 Iowans could be living with HCV (both diagnosed and undiagnosed), calculated as 20,535 divided by 0.15.

Calculation of the Range of the Number of Iowans living with HCV who are Undiagnosed

To calculate the number of Iowans who are living with HCV but have not been diagnosed, subtract the range of diagnosed from the range of people living with HCV.

To calculate the fewest number of people living with HCV who are undiagnosed, we assume that there are 35,865 Iowans with HCV and that 20,535 are diagnosed. In that case, 15,330 are undiagnosed (35,865 – 20,535).

To calculate the highest number of people living with HCV who are undiagnosed, we assume that there are 136,900 Iowans with HCV and that 19,726 are diagnosed. In that case, 117,174 are undiagnosed (136,900 – 19,726).

Contact Information

For assistance or questions regarding the Hepatitis C Epidemiological Profile, please contact:

Nicole Kolm-Valdivia, Ph.D., M.P.H.
HIV Prevention Program Evaluation Coordinator
Iowa Department of Public Health
321 E. 12th Street
Des Moines, IA 50319
Phone: (515) 281-6974
Email: nicole.kolm-valdivia@idph.iowa.gov

Randy Mayer, M.S., M.P.H.
Chief, Bureau of HIV, STD, and Hepatitis
Iowa Department of Public Health
321 E. 12th Street
Des Moines, IA 50319
Phone: (515) 242-5150
Email: randall.mayer@idph.iowa.gov

Patricia Young, R.N., B.S.
HIV and Hepatitis Prevention Program Manager
Iowa Department of Public Health
321 E. 12th Street
Des Moines, IA 50319
Phone: (515) 242-5838
Email: patricia.young@idph.iowa.gov